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JUL 13 1927

SCIENTIFIC AMERICAN

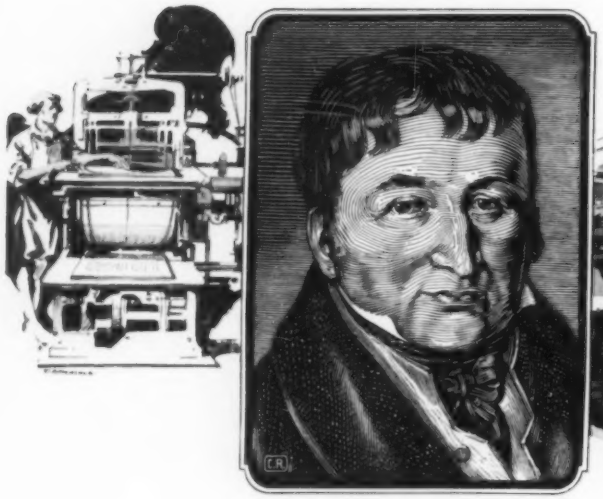
AUGUST 1927 *Thirty-five Cents a Copy*

ARE ATHLETES MACHINES?

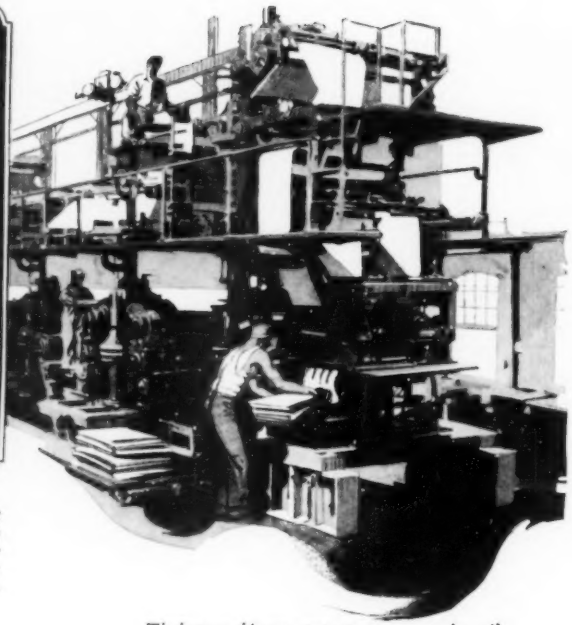
BY DR. A. V. HILL

NEW GOLF CLUB DESIGNS

SOCIAL INTELLIGENCE



Friedrich Koenig, inventor of the power press that produced the first newspaper to be printed by steam. It printed eleven hundred sheets an hour —about four times as many as the hand presses of the period, but less than the modern SKF-equipped press prints in ten seconds.



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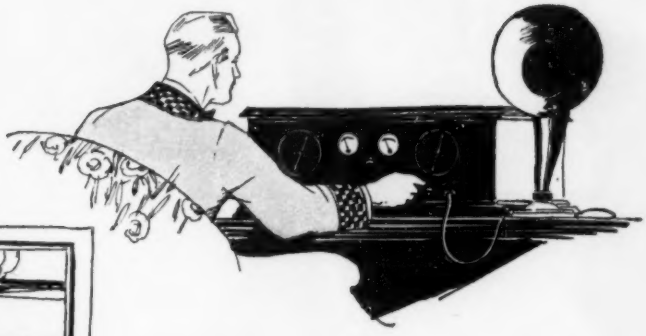

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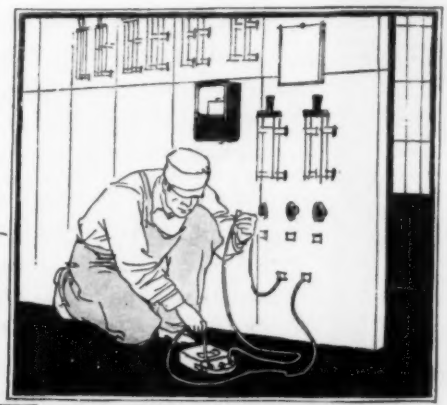

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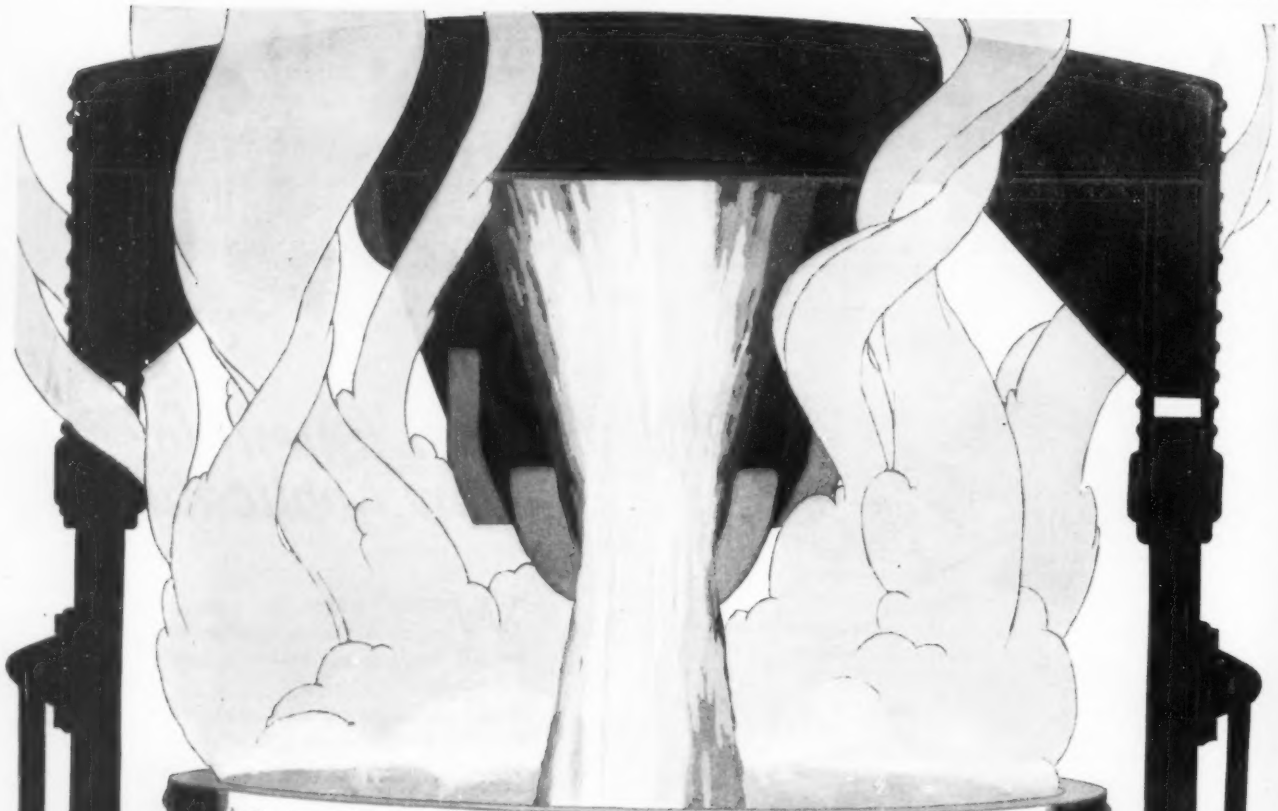
Scientific American, August, 1927. Vol. 137, No. 2. Entered at New York, N. Y., Post Office as Second Class Matter June 28th, 1879, under the Act of March 3rd, 1879; additional entry at Dunellen, N. J. Published Monthly by Scientific American Publishing Co., 24 West 40th Street, New York City. Copyright 1927 by Scientific American Publishing Co. Great Britain Rights Reserved. Subscription Price $4.00 per year



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SCIENTIFIC AMERICAN

August 1927 *Edited by* ORSON D. MUNN Eighty-third Year

Transmutation

ONCE more have the SCIENTIFIC AMERICAN'S transmutation experiments been confirmed. Dr. L. Thomason of the California Institute of Technology has just duplicated the methods employed by Smits and Karssen, two Dutch physicists who believed, nearly two years ago, that they had successfully transmuted lead into mercury. No results.

Last February Dr. M. W. Garrett, an English scientist, reported to the Royal Society that his attempt to transmute tin into indium by the same method was a failure.

A few months ago the noted German chemist, Dr. Fritz Paneth, came to the conclusion that his apparent former success in transmuting hydrogen into helium was without question a mistake, the trace of helium found having come from the glass vessel itself.

Two years ago Prof. Sheldon, Corresponding Editor of the SCIENTIFIC AMERICAN, conducted for this journal a duplication of the famous original transmutation experiment of the German, Prof. Miethe. No result.

Quite naturally we are pleased every time someone else confirms the SCIENTIFIC AMERICAN tests. Evidently the atom is having the last laugh.

Elephants

WANTED: An American elephant, twelve feet or more high and with curved tusks eight to twelve feet long. Has been seen in many states, but probably not since the glacial period. Went by the name of "mammoth" and was a poor relative of the well-known mastodon family. Anyone having news of his whereabouts kindly communicate with the officials of the United States National Museum, Washington, D. C.

Unless the National Museum can find an American elephant in one piece, it plans to assemble one from tusks found in one place, a backbone 2000 miles distant in another, and four legs found in four other places. Such a conglomerate skeleton is being assembled now, but the skull and pelvis are still missing. In the absence of a complete framework a skull and a pelvis will be gratefully received.

Thanks

Gratifying indeed has been the response of our readers to the new form of the SCIENTIFIC AMERICAN. Many of them have written to us, telling why and how much they like the change. We are answering all of these letters as fast as possible, but in the meantime, we want to take this space to thank all of those who have written to us, but have not as yet been answered. Up to date we have received only one adverse comment. We would greatly appreciate hearing from the rest of you, giving your criticisms as freely as your praise.

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Health

ULTRA-VIOLET radiation is beginning lately to come in for quite a lot of popular attention. It is getting into the newspapers, which means that a lot of people are going to be badly misled about its nature and uses. Several kinds of special glass and other materials which will transmit ultra-violet radiation of health-giving value (ordinary window glass will not) have been put on the market and advertised, and are beginning to be used in hospitals—occasionally even in homes.

What will ultra-violet radiation cure? Can the layman obtain an ultra-violet radiation lamp and use it himself for home treatment? Are the "violet ray" outfits sold at some drug stores any good? (Answer: No). Exactly what is ultra-violet radiation, anyway?

One of our sub-editors says he has heard so much nonsense and hocus pocus about this subject during the past few months that he is getting mad, and may inflict on our readers a series of articles about it. Can you stand it?

Islets

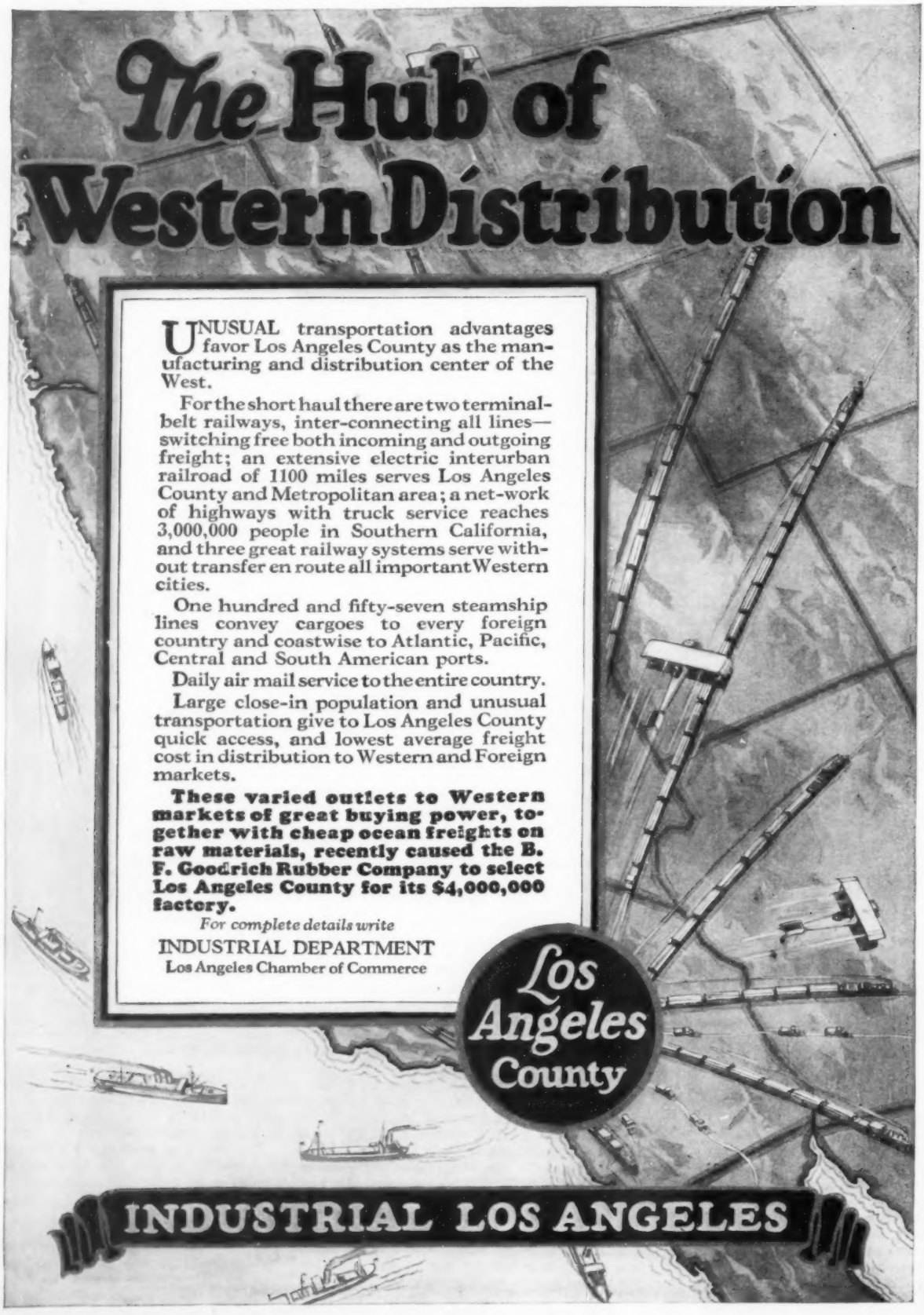
HOW many Hawaiian Islands are there? You probably could not guess within five of the correct number. The SCIENTIFIC AMERICAN does not know the answer; even the United States Government, which owns the Hawaiian Archipelago, is unable to tell you.

The Coast and Geodetic Survey would like to know, however, and a report soon will be made showing what additional work will be necessary to place all the islands on the charts. The uncharted ones are small and lie to the westward of the main Hawaiian group.

The world is a pretty big place yet, even though science has been making it smaller every year.

Cover

OUR cover illustration this month, painted for the SCIENTIFIC AMERICAN by Howard V. Brown, depicts the unusual cable-painting method which is described in complete detail on page 113.


The Hub of Western Distribution
UNUSUAL transportation advantages favor Los Angeles County as the manufacturing and distribution center of the West.
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Among our Contributors

PROF. HENRY NORRIS RUSSELL

Regularly for twenty-seven years Dr. Russell of Princeton has contributed to our pages a monthly article on astronomy, yet we do not recall that we have ever published his picture. For one thing we could not get him to send us one, and we had to obtain this one from an outside source. In doing this we knew our regular readers were anxious to make Dr. Russell's more intimate acquaintance. Here in the office we always look forward to the arrival of his monthly manuscript, for his articles interest us as much as they do our readers.

HAROLD J. COOK

Harold Cook is the author of "On the Trail of Ancient Man," in this issue. He is an able oil geologist—but his hobby, which he rides hard, is paleontology, the study of evolution by means of fossil evidence. Harold Cook's home ranch in Nebraska is literally "alive" with fossils of Tertiary mammals and it was his boyhood association with them that led him to specialize at the University of Kansas in geology. The discoveries made by and through him may force the revision of some hide bound text-book ideas. Frankly, we hope they will.

Prof. A. V. Hill

If you are interested in athletics Prof. Hill's article on page 124 will hold you. He has been experimenting on the track athlete just as if he were taking indicator diagrams on a locomotive. And after refining his research to a science he finds that the athlete really is a kind of locomotive—so much fuel; so much "steam"; so much speed. It is surprising how exact a science he makes of it.

Prof. W. J. Humphreys

Dr. Humphreys' specialty is the weather, but not so much in the ordinary sense of the word as in the sense of the fundamental causes of the weather—the physics of it. He is not the man that makes the weather predictions, but the man that supplies the underlying principles that enable the man that makes these predictions, to make them. Read what he says on page 105, concerning tornadoes.

D. McFarlan Moore

Who first designed golf clubs, anyway, and why did he design them as he did? Is there any compulsion to stick to the present form of club? Suppose a man sat down to redesign the clubs and disregarded tradition entirely, starting anew with only the idea of arriving at the form that was most efficient, what would he work out? That is what Mr. Moore has done in his able article on page 120.

Dr. F. A. Moss

There are intelligence tests and intelligence tests. At first, when they were new, many people jumped to the conclusion that from them you could deduce a person's capabilities. Now we know better—they only help in a general way. Prof. Moss has found a better way. It recognizes that as a rule people who are good mixers make out best. How to pick these people is told on page 108.

Looking Ahead

with the Editor

ENCEPHALITIS

Epidemic encephalitis is the scientific name of the disease popularly called "sleepy sickness" (some wrongly term it sleeping sickness). How to conquer this dread scourge? Hard work is being put on the problem. Next month Dr. Flexner, head of the famous Rockefeller Institute, will tell us what has been accomplished.

IMITATION

Sir Richard Paget, British physicist and inventor, who has specialized in investigation of the human voice and who has succeeded in producing models which imitate all the sounds of English speech, will tell us how it is done. Oddly enough, you can make an artificial speaking box with your own two hands!

IDEAL

Suppose you could plan a whole city right from the very beginning—no existing features to hamper you. What great fun it would be! That is what Ernest Flagg, the famous architect and innovator in building, has been doing. Next month he will tell you what the ideal city of the future will look like.

TUNNELS

In our next issue, we shall have an article on the opening of the vehicular tunnel between New York and New Jersey. This marks the completion of one of the world's greatest engineering works. Other vehicular tunnels have been built but this great highway beneath the Hudson River, because of its size, capacity and length, stands in a class by itself, and has no competitors.

RACING

To the mathematician an article to be published next month will reveal some interesting and surprising facts about oarsmen and shell racing, of the general nature of the findings on athletes so brilliantly illuminated by the noted Dr. Hill in the present issue.

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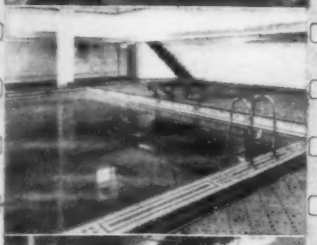
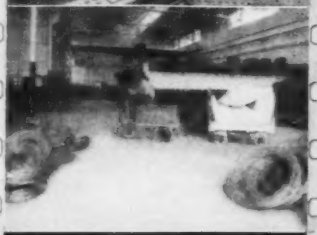




The outstanding assets of ALUNDUM TILE and TREADS are long life and slip-proof walking surface.

Next in importance is the architect's opportunity for selectivity in colors and arrangement.

NORTON

Grinding Wheels
Grinding Machines

Refractories-Floor
and Stair Tiles

Wide World Photo

COLONEL CHARLES AUGUSTUS LINDBERGH

Called on to write a legend "introducing" Colonel Lindbergh to our readers the editor is rather whimsically reminded of the famous letters of introduction which the modest young aviator thought it advisable to take with him when he flew frow New York to Paris, in order to make sure that when he landed he would not have to go about the city of Paris unknown and unrecognized! Nobody in the world now needs to be told whose picture this is and what Colonel Lindbergh did—at least if there is anyone we doubt whether he is a typical reader of the SCIENTIFIC AMERICAN

Wide World Photo

Two Miles Distant—An Oklahoma "Twister" of Last Spring

There are two motions in a tornado, the whirling motion and the forward progression of the whirlwind as a whole. A tornado becomes visible, according to Dr. Humphreys—author of "The Physics of the Air," a textbook which is noted among scientists, and of the article on the opposite page—because the rapid rotation of the air expands it. When air expands it cools. When it cools its vapor content is precipitated as droplets. These make it visible and outline the tornado.

TORNADO AT LEBANON, KANSAS, 1924

It is only when a tornado happens to cross a populated community that we hear of it. Some of the worst tornadoes pass over open country and do little damage

Our Worst Storm, the Tornado

What Combination of Natural Forces Causes Tornadoes, and Why They Hit the Middle West So Hard

By DR. W. J. HUMPHREYS

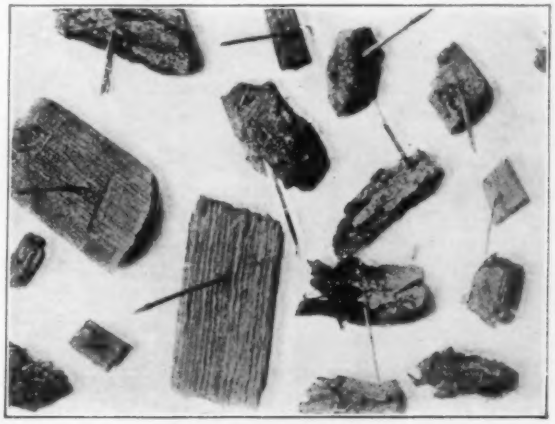
Professor of Meteorological Physics, United States Weather Bureau

THE tornado, or "twister" of the American prairies, is the most violent of all storms. Attempts to explain it have been as confused as the wreckage in its path. There even is confusion as to what to call it. The name used by the United States Weather Bureau is "tornado." Many, however, especially those who live in the regions most frequently visited by this storm call it a "cyclone." But the man in the field, with the uncanny accuracy of the freshman in nicknaming professors, calls it a "twister." This is bad enough, but there is more uncertainty still, since the very origin of the technical term "tornado" is in doubt. Furthermore, if its origin is what it seems to be, then the meaning given to it is forced and not inherent.

Most likely this word came, perhaps through bad spelling, from the Spanish word *tronada*, a thunderstorm. For 200 years English sailors used a word like unto this, variously spelled, in their accounts of severe local thunderstorms along the west coast of Africa and on the tropical seas.

These storms often are accompanied by exceedingly variable winds that sometimes box the compass in an hour's time or less, evoking surprise and comment on the part of sea captains familiar only with the storms of higher latitudes. Hence the idea of turning became prominent in the minds of those who wrote of this type of thunderstorm, and so at last the name for it became tornado, its present spelling, on the erroneous supposition that it came from the Spanish *tornar*, to turn. We do not know when this name was first applied to the "twister," but we do know from Luke Howard's "Climate of London" that it was so used in England at least as early as 1809 and in America by or before 1814.

The tornado, as we now understand the term, is a slightly funnel-shaped, circular column of upwardly spiralling winds of great velocity. It may or may not reach the surface of the earth, but where it does, practically everything it touches is torn to pieces. It is not as sharply outlined, of course, as a rotating solid. Nevertheless, the distance from the path of great destruction to the region of little or no injury is so amazingly short that houses on one side of a street may be demolished while those on the opposite side are not injured.



VELOCITY DID THIS

A collection of straws driven end on into the bark and wood of trees, by tornadoes of high velocity

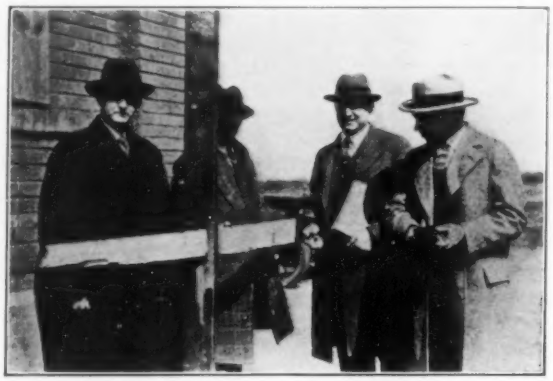
THE width of the tornado track varies from only a few yards to a mile or more, and its length from a few hundred yards to two or three hundred miles. A rough average would be one fifth of a mile across and 20 miles long, or a total area of four square miles. In round numbers there are 100 tornadoes in the United States every year; 250 people killed by them, and 8,000,000 dollars damage done to property. These totals are large, and would be alarming

if we did not recall that they are very small in comparison to the total population and wealth of the nation. If tornadoes were the only cause of death, even we of the United States, where tornadoes are more numerous than in all the rest of the world together, would have a life expectancy 200 times the age of Methuselah. Tornado danger therefore is not relatively great.

Nevertheless, what with the decrease of pressure within the column, roughly 200 pounds to the square foot, and the velocity of the whirling wind, often at least 400 miles per hour, the tornado is dreadful and the things it does are all but incredible.

HOUSES are demolished, their walls blown out and roofs lifted off. Sometimes a house is raised clear of its foundations and smashed to the ground out in the yard or farther away, furniture and even stoves carried high in the air and far away, wagons hurled across the sky, stock blown from one farm to another, generally killed, but occasionally none [the worse for their wingless flight; even people borne, as by an Alladin's carpet, but more swiftly and amidst a cloud of wreckage, perhaps half a mile or more, and then dashed to death, or, as sometimes strangely happens, set down gently and left to their own wonderment and thanksgiving. Freight cars have been upset, boards driven a yard deep into the ground, straws stuck end-on through the bark of trees and into the wood, clothing torn from the body, and even fowls somehow stripped of every feather. And so the disasters and the pranks of the tornado, from the terrible to the ridiculous, are of endless variety.

Somewhere in the Mississippi Valley a spring or early summer day has been hot and sultry with a moderate wind from the southwest. Then a towering cumulus gathers in an otherwise clear sky, or more likely in a sky already overcast. Presently, the clouds at a particular place appear to be rushing past or around each other. Then a swaying fog-like column extends down from the place of rotation, and the dreaded roaring tornado is on its course of destruction, with lightning, hail and thunder as mere incidentals.



NEAT TORNADO WORK

Engineers examining a one-inch by five-inch board which was blown through a two-inch by six-inch plank, by the force of an Illinois tornado

But what caused it?

There are only a few ways by which rotation can be produced in a fluid. A vortex can be generated by rotary stirring, but the tornado is not caused in that way. Again, whirling eddies are formed when a stream of fluid passes by an obstacle, as for example when the wind blows past the corner of a house. But this, too, must be ruled out as a possible cause of the tornado. Friction between passing currents generates vortices at their interface, but we know that the tornado is not so produced, because the linear velocity of a particle in such a whirl cannot exceed the velocity of either current with respect to the other, and that no straightaway air current ever passes another with a velocity half as great as the maximum in the vortex of this storm.

There remains but one other possible source of vortex rotation, and it therefore must be the cause that somehow produces the tornado. This is the drawing in, to shorter radii, of portions of the fluid already having some rotation about a center, by virtue of which the linear velocity always tends to increase in the same ratio that the distance from the center decreases. This is the cause of the common vortex in the water of an emptying basin, and of the spin of the familiar dust whirl, which although having some of the characteristics of the tornado is very gentle, originates at the surface of the earth, and spins either clockwise or counterclockwise, whereas the tornado is violent, starts at the cloud level and always rotates in the same sense—counterclockwise in the northern hemisphere.

AS already explained, the tornado seldom if ever occurs outside the warm portion of a cyclone, or large area of reduced atmospheric pressure and widespread cloudiness and precipitation. In fact it occurs more or less to the east of the windshift line, a line that in the United States, to be specific, runs from the place of lowest pressure hundreds of miles towards

MORE TORNADO DESTRUCTION

A windmill after a tornado in Kansas. Wind pressure increases very much more rapidly than wind velocity—at 50 miles an hour it is 12 pounds per square foot; at 100 miles an hour, 49 pounds; and so on at a rapid rate of increase

FIFTY WERE KILLED

Griffin, Indiana, after the tornado of March 18, 1925. Out of its population of 350 residents, 55 were killed and 200 were injured by this "twister" which virtually ruined the community for the time. The vehicle shown is a hearse

WHAT AN INDIANA TORNADO DID

A tornado which visited Princeton, Indiana, March 25, 1925, ruined a catsup plant, killed several and did great damage

MORE WRECKAGE AT GRIFFIN, INDIANA

Here is the ruin of someone's home, pieces of broken furniture being visible. Picture your own home reduced to this

the southwest and moves eastward across the country with the travel of the general storm. To the west of this line, the winds are from points north of west. To the east of it, very generally from the southwest. Hence, as this line passes any given place, the relatively warm winds from southerly or southwesterly points

BLACK AND OMINOUS

A tornado at Solomon, Kansas, 1905

are quickly followed by cooler winds from the northwest. This is why it is called the windshift or squall line.

The rush of the oncoming colder wind is retarded by friction and turbulence throughout the lower 1500 feet or so. Hence, in this layer the wind commonly grows stronger with increase of height, and therefore in many cases runs forward over the warmer surface air from the southwest, entrapping it and pushing it up to greater heights, just as the warm air in a chimney is pushed up by the cooler and denser air outside. When this warm air is quite humid, as it often is, the moisture in it condenses to cloud as it reaches a moderate height and then, because of the latent heat thus set free, becomes all the more buoyant and swifter of ascent—the higher the worse until the supply of moisture begins to fail.

IN this way many local, turbulent thunderstorms are produced in the general region of the windshift line. Now, these thunderstorms, however turbulent, ordinarily are not accompanied by rapidly rotating winds. Their convection is of lower air all moving in one direction up through another layer where likewise all is moving in a common direction, however different from that at the surface. Neither at the surface, therefore, nor in the overflowing air are the conditions such as to produce rotation, and of course, rotation does not occur. Nevertheless this is the general region in which tornadoes develop.

When the temperature of the southerly air decreases slowly with increase of height, as often happens, and the overflowing air is not very cold, this upper wind sinks through the lower only slightly. If it sank far, it would become warmer, owing to increase of pressure, than the air through which it was falling, and thus become the lighter of the two, a manifestly impossible condition. Hence it merely floats out over the lower wind and the windshift line is in midair, and not, as it usually is, at the surface of the earth.

At this level there is little friction and the northwest wind, having the same velocity through a considerable depth, may have a roughly vertical front of some height against the southwest wind. Furthermore, the northwest wind (as seen from the surface of the earth) and the southwest are both moving eastward at the same rate. Hence in reality they are flowing beside each other in opposite directions, but with the southerly wind, owing to the rotation of the earth, always on the forward or east side.

Convection along the vertical interface between these two winds, one of which, the southern, is very humid, would produce much precipitation, and strong rotation in midair by drawing towards a common center oppositely directed winds on the two sides. This rotation would always be counterclockwise in the northern hemisphere, and when very vigorous would gradually feed down to the surface of the earth and have all the characteristics of the tornado.

THE MIAMI TORNADO

This is the famous storm of 1925

Presumably, therefore, this terrifying storm is caused by convection between walls of northwest and southwest winds flowing past each other along a windshift line in midair—conditions strongly favored by the position of the Gulf of Mexico and the trend of the Rocky Mountains.

Are You Socially Intelligent?

An Analysis of the Scores of 7000 Persons on the George Washington University Social Intelligence Test

By F. A. MOSS and T. HUNT
Department of Psychology George Washington University

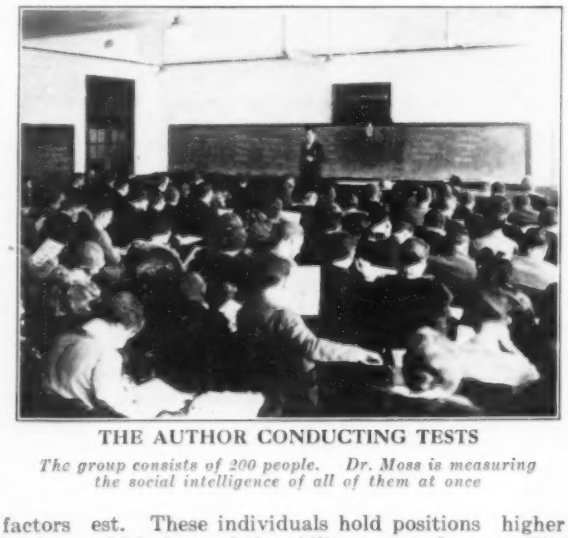
THE Declaration of Independdence is wrong! People are neither born equal, live equal, nor die equal. These inequalities among people are just as great in the case of the natural abilities and aptitudes which they inherit from their ancestors as in the amount of money that is left them by these same ancestors. Some are born geniuses; most have only average intelligence; while an unfortunate few have such defective mentality that they must live and die as idiots. Some make friends without effort; the majority have no special ability either for making or for losing friends; while a few have such thorny dispositions that their mere presence is uncomfortable.

One of the most important of the natural abilities in determining success in the world is ability to get along with others. Differences in this trait are now being measured by the Social Intelligence Test, which was devised by members of the Psychology Department of George Washington University. Since its initial publication, two years ago, this test has been used extensively by personnel officers in industry and by 52 different educational institutions. The test has been given to approximately 12,000 persons. About 7000 of these tests were available for analysis. The study has been directed toward discovery of the factors underlying or contributing to this important trait of social intelligence.

IN the analysis, an effort was made to answer five questions: (1) How do the different vocational levels compare in social intelligence? (2) What is the effect of age on social intelligence? (3) How do the sexes compare in social intelligence? (4) Is ability to get along with others inherited? (5) What is the effect of education on social intelligence? Let us now see how these questions are answered from the data.

Is it possible to predict, before he actually tries his hand at it, which person will be able successfully to manage a hundred subordinate employees; which person can negotiate business with members of other business firms; which person can get along with a large number of fellow employees of equal rank; or which individual can successfully deal with numerous clients and consultants? In solving such questions lies the great value of a measure of ability to deal with people. Studies of the Social Intelligence Test being used with the groups discussed in this article indicate the practicability of such predictions.

The accompanying tables show the average ratings or scores on the Social Intelligence Test made by different occupational groups. As we would expect, employees in executive and administrative positions score the highest. These individuals hold positions which demand the ability to get along with others, either with employees under their direction, or with persons of equal ability with whom they must deal in a business way. In this group the chief requirement for success, presupposing, of course, sufficient general ability to manage the details of the job, is superior ability in dealing with people; and it is found in testing them that this is where the superiority actually is. About 90 percent of those who have made good in executive and administrative positions make scores as good or better than the average social intelligence score of employees in positions where no occasion arises for direct dealing with others.



THE AUTHOR CONDUCTING TESTS

The group consists of 200 people. Dr. Moss is measuring the social intelligence of all of them at once

Other occupational groups show gradations in the degree of social intelligence which is required. Those in the teaching profession score high in comparison with occupational groups at large; salesmen for industrial concerns are high; industrial foremen are above average. Those who exhibit least ability on the test of social intelligence are the ones in minor or subordinate industrial positions where there is little need to make adjustments to other people beyond a general obedience to immediate superiors. Their positions practically never require the initiating of social relations, and the demands for skill in carrying on those initiated by others is very slight.

THE scores on the test made by some occupational groups are much more variable than those for other groups. For example, in an average industrial group, half the scores are scattered over a range of 17 points, while in a group of administrative officers the same percentage of scores is limited to a range of 10 points. As a rule, those in positions with high social-intelligence requirements all score high, those in the very lowest types score low, while in intermediate groups a much wider variation is found. This may be partly accounted for by the fact that, within this middle group, seniority has been substituted for ability in the case of some of these; or youth and inexperience have not yet permitted some of superior ability to reach the higher positions.

Within the various occupational groups, the highest scores are, in general, indicative of the greatest success. In one of the higher industrial groups, the highest fourth in ability, as estimated by a superior executive in the concern, all fall in the highest third of the Social Intelligence Test scores. In another group of somewhat lower grade, two thirds of those scoring above average in social intelligence were rated above average in ability to carry on business relationships. Very few cases have been found of individuals with outstandingly high social-intelligence ratings who have been unable to manifest their ability in a practical way; and on the other hand, almost no "shining successes" have been found among those scoring very low on the test.

In school and college groups, ability

to deal with others, both with teachers and fellow students, is an important factor in success. The scores for college students are high, for college graduate students even higher. In the lower school levels, the responsibility of getting along with all concerned rests largely on the teacher; in college, the responsibility is to a large degree transferred to the student; and the graduate student has practically all the responsibility himself. The correlation of school success as measured by school marks with social-intelligence scores is fairly high.

The testing of a large number of individuals in various vocational groups furnishes a basis for arriving at standard scores for each group. These scores, established by testing those already successful in different positions, can be used as standards in admitting new employees or members to the groups. Such a procedure can be followed, since social intelligence is very largely an innate quality or one which is built up in large degree before the vocational stage of life; and not a quality gained by experience in a position requiring it. The point should be emphasized that the "big executive" scores high on the Social Intelligence Test, not because he has gained experience by being a big executive, but because he originally had the ability to become a big executive.

Scores for Various Occupational Groups

Group	Number of Cases	Average Score	Range of Middle 50%
Industrial groups	200	64	17.0
High school students	618	83	14.0
College freshmen	4181	98	13.5
Upper class college students	1000	111	12.0
College graduates	100	113	12.0
Employees in executive and administrative positions	100	117	10.0

All ages of adult life have their claim as to individuals with high social intelligence. In one business firm in which the Social Intelligence Test was given to the employees, the outstandingly high score on the test was made by one of the youngest members of the organization. In another organization the prize scores were made by older members who had several years ago earned their rank through their ability successfully to carry on business relationships and dealings.

SO it is in individual cases in other groups—one school finds that its popular young campus member, who so easily manipulates the school politics or influences his classmates, is rated at the top in social intelligence, while another school finds that some older individuals, who have already made a place for themselves in world affairs but who may be in college to brush up on a few modern theories, come out on top.

An analysis of the scores of a large number of individuals from 13 years of age to average adult age shows that after the age of 18 or 20 has been reached, age has very little to do with their ability to deal with others—or their social intelligence. From early childhood to the age of 18 or 20, one's social intelligence increases somewhat regularly, but after this period there is no appreciable gain. The person of 18 or 20 years of age is just about as likely to make a high rating in these tests as the one of 35 years.

The average social-intelligence scores of several hundred upper-class college students of different ages vary within only a few points out of 160. College freshmen show slightly more variance but no definite age tendency. Industrial groups composed of individuals of about equal industrial rank similarly, show closely corresponding scores for different ages, the slight advantage being in favor of the younger worker. The slightly higher standing of the younger worker can be accounted for partly by the fact that those who would have made the highest scores in the older age groups have moved on to a higher industrial group, largely because of their innate higher ability, of which social intelligence is a factor. This would seem to indicate that, although the young men may be denied the better jobs because they are too young, the justice of this procedure cannot be based on undeveloped powers in this innate ability which is one contributor to success.

Average Scores According to Age.

Group	Age in Years 13	14	15	16	17	18	19	20	21	22 & over	30 & over
Upper class college	....	....	....	....	113	112	112	112	108	114	114
College freshmen	....	....	....	....	105	105	98	101	99	100	105
High school students	82	84	88	92	89	88	....	....	....	....	....

An analysis of the separate factors in social intelligence in relation to age gives a few interesting findings. There are certain separate factors which have a tendency to vary with age. The older individual is usually found to have greater breadth and variety of interests, and, since being interested in what others are interested in bears directly on ability to get along with them, such a difference may be significant. This difference is borne out in the Social Intelligence Test by the higher scores on a test of social information made by the older individuals. From high school groups to college groups in which age is one important difference, although it must be remembered that there are many other differences to be considered, the average score in social information is increased about 50 percent; while in the abilities of memory for names and faces, and interpretation of emotions from either facial expression or spoken words, the increase is usually less than 15 percent. Within the college group itself, and within business groups, the social information score is found to increase with age, but less markedly.

IN judgment in situations involving relationships with others, the experience accompanying age adds some to the accuracy or correctness of judgment; but with increased experience and resources in the form of a greater number of criteria against which to evaluate solutions of social problems, the individual seems to lose in speed of making his judgment. The younger individual has a tendency to make his judgments in dealing with others a little more quickly but he is a little less likely to reach the best solution. Other factors show only slight variations attributable to age, beyond the change in ability which one would find on any written test in advancing from the child to the adult person. Age with its accompanying experiences may be expected to increase one's fund of social information and his criteria of social judgment, but the slight gains that he makes in these respects seem to be offset in other respects.

In general, we must conclude that what the individual does not possess in ability to deal with others at 16, he is not likely to possess in high degree as he reaches middle life or old age. The individual who, in youth, cannot make social adjustments with his classmates, who cannot deal successfully and amicably with problems involving his classmates, who rubs people the wrong way or forgets the courtesies due them, will do likewise in later relationships where his classmates have changed to business associates or his school problems to business deals.

Is one sex naturally more socially intelligent than the other? A canvass of popular and scientific opinion shows a vote in favor of the women. Popular opinion takes its stand on the supposedly greater need of women to get along with people, greater interest in social affairs, and a tendency toward agreement or acquiescence in circumstances where the man would argue or fight. Scientific opinion cites the psychological studies attributing to women greater interest in people as compared with man's greater interest in things. Analysis of over 1000 scores on the Social Intelligence Test for college men and women does show the women to be slightly superior

Wherein does the superiority of the women lie? An examination of the separate factors of social intelligence may help to answer this. First, it is found that the difference does not lie in ability to remember names and faces —for here no appreciable difference between the sexes exists. The average scores on a test of memory for names and faces are practically the same. The only tendency found, although this is not significant, is for the women to remember faces better and the men names better. The chances are just about equal that Mr. Jones or his wife will remember you after you have been introduced to them once.

Nor is the superiority of women due to better ability to interpret human emotions. In seeing the mental state behind either the facial expression or the spoken word, equality of the sexes is the rule. One sex may be more emotional or more inclined to express emotions, but this does not carry over to a difference in ability to interpret emotions when they are expressed in others.

IN range of interest or social information, the men even surpass the women. As measured by a test of 50 questions on social information, the men usually score from 15 to 20 percent better than the women. Whether men have an innate superiority along this line or whether they have had wider contacts and opportunities to develop interests and acquire information is not certain, but however the case may be, in this respect they possess a present advantage.

The two factors which analysis has revealed as accounting for the higher social sense or intuitiveness of women are the ability to make judgments in social situations requiring tact for their solution, and observation of human activities which serves as a basis for the predicting of behavior in others. Women score from 15 to 25 percent better in these abilities than men usually do.

Differences may be indicated by a few concrete examples from the test. Women are successful in recognizing the falsity of these statements about twice as often as are men:

"The more uncivilized and superstitious a nation is, the higher is the rate of suicide."

"By original nature we find it satisfying to be alone in our beliefs and opinions."

Men fail to recognize the truth of these generalizations over twice as often as do women:

"We are more shocked by our errors in etiquette than by those in logic."

"Few people hesitate to lie to escape an unpleasant engagement."

Differences in the use of tact in meeting social problems can be specifically illustrated by two of the problems presented in the Social Intelligence Test. First, to take an example of friendly social relations; in deciding on a book suitable for a gift to a friend, the alternatives are to find out from the friend what kind of books he likes, to ask advice of a book dealer, to give a book you have enjoyed, or to give a "best seller." Eighty-eight percent of the women chose the first alternative, which is obviously the best thing to do. Only 68 percent of the men would do this.

To take a situation involving business relationships, the problem is presented of dealing with a business associate who has no authority over you but who dictatorily tells you to do a thing quite differently from the way you had intended. All except about one fourth of the women would ignore him, which is the best way to meet the situation. A much larger percentage of men would attempt to meet the problem in a different way, a considerable number choosing to take the aggressive attitude of telling the associate it is "none of his business," or telling him to do the job himself.

What may these differences mean in a concrete way, if anything? It may mean that, other things being equal, man has a little better chance of holding the prospective business client or benefactor by appearing intelligently interested in his hobby or by being able to discuss the topics of conversation in which the latter is interested; but that woman has a little better chance of selecting the right tactics to use in bringing the client or benefactor to the desired point of view, or of predicting his reactions under a given set of circumstances. It would seem that man is to be given the preference in initiating social relations, woman in safely completing them.

IF an individual can get along successfully with his associates, the chances are much in favor of his brother possessing a like ability. The Social Intelligence Test scores of 38 pairs of siblings were studied. While this number of cases is admittedly too small to permit any sweeping conclusions, it is enough to indicate certain tendencies.

In all cases where the resemblance between children of the same parents have been investigated, there has been found to be a positive correlation. Brothers and sisters tend to do work of similar grade in school, they show considerable resemblance in abstract intelligence, and the correlation between brothers in physical traits is as high as .50 or .60. The correlation between the Social Intelligence Test scores of brothers and sisters is not so high, being about .44; but it is high enough to indicate that inheritance plays a very important part in determining ability to deal with others.

The inheritance of social intelligence is evidenced in families of statesmen, politicians, and courtiers. History is so full of instances where several members of the same family have made shining successes in the fine art of human engineering, that no one can doubt that our amount of social intelligence is just as much a part of our inheritance as is our stature.

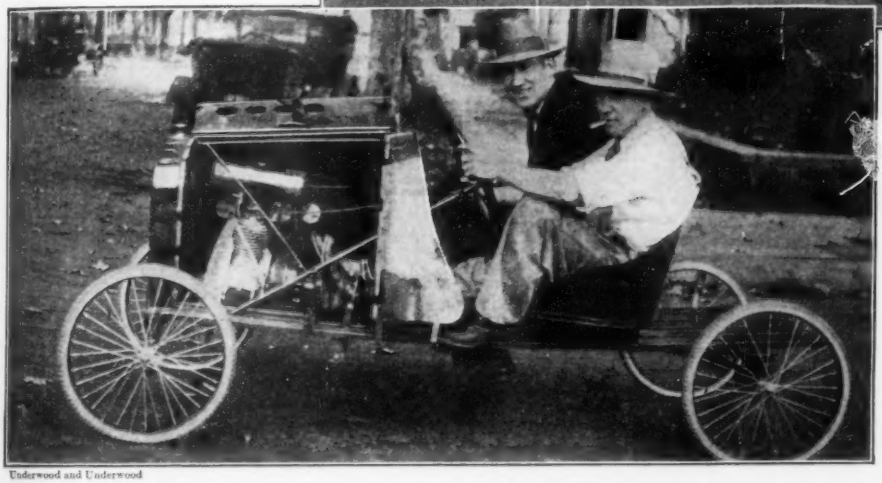
And so it is seen, that one's success in the fields of the various vocations or the preparation for the various vocations is determined in no small part by the amount of social intelligence with which he is born.

MENTAL STATES INDICATED BY FACIAL EXPRESSIONS

Business executives surpass all others in tests for the perception of such indications

ELECTRIC "SCOOTER"

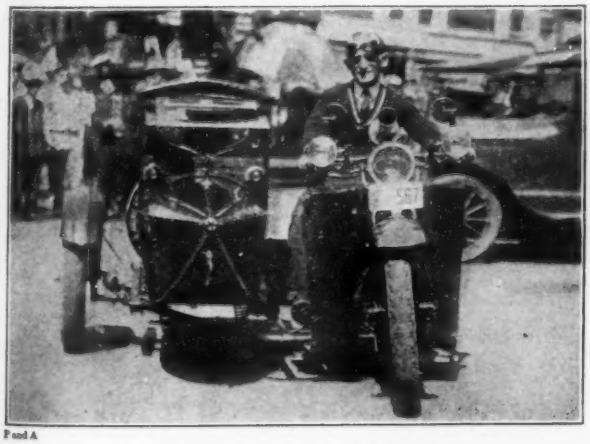
The miniature electric roadster illustrated at the right is so designed that on one charging of its two six-volt batteries, it will travel at about 15 miles per hour, for a distance of from 20 to 30 miles, according to the road surface. To start, it is only necessary to press a small foot pedal. This actuates a two-step resistance, thereby making the vehicle start smoothly and preventing the placing of a sudden load on the battery. Two brakes are provided, one operated by hand and the other by foot. When either brake is actuated, the circuit is broken



Underwood and Underwood

PORTABLE AUTOMOBILE

The tiny single-cylinder gasoline engine in the small automobile illustrated at the left is capable of driving the car at a speed of 12 miles per hour, with remarkable economy. Because of the extremely small size of the vehicle, it can "wriggle" its way through heavy traffic with ease, and can be parked in a very small space. In fact, it can be parked by the simple expedient of picking it up, one end at a time, and carrying it into the parking space. The machine is equipped with standard bicycle wheels and tires. The chassis is of the buck-board type



Pond A

A MOTORCYCLE DE LUXE

The side-car of this outfit is fully equipped with every convenience and safety device, and is said to have cost 2000 dollars. It has 12 electric lights installed in it

Wide World

MOTOR-WHEEL "SCOOTERS"

These little motor vehicles, using motor wheels, were designed and built by two seniors at Massachusetts Institute of Technology. They can travel at a rate of 25 miles per hour

Novelties in Automotive Transportation

Every once in a while we see some type of freak motor vehicle on the streets. In the above photographs, we present four representative types. Probably the most interesting of them, at least from a financial viewpoint, is the motorcycle outfit illustrated in the lower left-hand photograph. The motorcycle itself has three warning signals—an electric horn, a hand horn, and a whistle. The side-car is fitted with 12 separate electric lights, and the seat can be so adjusted as to form a comfortable bed. The side-car cover is completely waterproof, and is equipped with sliding windows on both sides. Specially designed springs make the vehicle exceptionally easy riding.

OUR POINT OF VIEW

THE MOTOR AND THE MAN

IN speaking of transatlantic flights, it is no disparagement of the man to place a reliable motor in the first position as the absolutely indispensable element for a continuous nonstop flight across the northern Atlantic. Three times this supremely hazardous feat has been accomplished—first by Alcock and Brown in 1919 in a twin-engined, military bombing machine and eight years later by Lindbergh and Chamberlin in monoplanes, each driven by the wonderful Wright Whirlwind engine—these last two flights of 1927 being made with a brief interval of only two weeks between them. In each case the engine represented the highest development of the gasoline engine of its day—the Alcock plane being driven by water-cooled Rolls-Royce engines—the Lindbergh and Chamberlin monoplanes carrying what is universally admitted today to be the most reliable air-cooled airplane motor ever produced. It has to its credit the long-distance record of over 51 hours in the air made by Chamberlin in his Bellanca plane, some few weeks before he made his flight from New York to Germany.

Until recent years, the plane itself has been well in advance of its motor in respect of reliability. Smith in his flight of 14,000 miles to Australia over an unchartered course, Cobham in his flight of 12,000 miles from London to Cape Town and back, and shortly thereafter in his flight of 24,000 miles from London to Australia and back, the flight of our army fliers around the world and the flight of Byrd from Spitzbergen to the North Pole and back in his great Fokker tri-motor monoplane—all these and many others have shown that the plane itself has reached a point of absolute reliability.

And now the marvelous flights of Lindbergh and Chamberlin have proved beyond question that the motor has been brought up to the same high pitch of reliability as the plane.

As regards the man, in such daring flights as that across the northern Atlantic, we must remember that in the three instances where this has been accomplished, the aviator has been a man of long experience, possessed of an unusual air-sense, and thoroughly familiar with the atmosphere's troublesome vagaries. Alcock was a veteran war pilot and both Lindbergh and Chamberlin have been brought up in that wonderful school of experience, the Air-Mail Service. Do not for a moment imagine that just any pilot, even though he were provided with the same excellent planes and motors, could have gone out and done what these young men so brilliantly accomplished. All three of them ran into difficult air conditions; Alcock and Brown flew almost continuously in fog and thick weather, so much so that Navigator Brown had to wait many hours in the air before a rift in the clouds allowed him to take an observation. Both Lindbergh and Chamberlin had to contend for many hours with the peril of ice and sleet.

The reason why young Lindbergh's feat has so captured the imagination and enthusiastic applause of the world is to be found in the quiet courage with which he flew across America and then, at the first intimation from the Weather Bureau of favorable conditions on the Atlantic, climbed into his machine and swept out to the great adventure, utterly alone, and made his objective, 3600 miles distant, with unerring accuracy. Couple with this the native modesty with which he has taken the amazing honors which have been showered upon him, and his absolute refusal to commercialize his exploit in a world which is saturated with commercialism, and you have an explanation of the warmth with which a war-wearied and money-satiated world has taken this fine young American lad to its heart.

Ex-Secretary Hughes says:

"WE are all better men and women because of this exhibition in this flight of our young friend. Our boys and girls have before them a stirring, inspiring vision of real manhood. What a wonderful thing it is to live in a time when science and character join hands to lift up humanity with a vision of its own dignity. There are again revealed to us with a startling suddenness, the inexhaustible resources of our national wealth. From an unspoiled home with its traditions of industry, of frugality and honor, steps swiftly into our gaze this young man, showing us the unmeasured treasures of American character. America is fortunate in her heroes; her soul feeds upon their deeds; her imagination revels in their achievements. There are those who would rob them of something of their luster; but no one can debunk Lindbergh, for there is no bunk about him. He represents to us, fellow Americans, all that we wish—a young American at his best."

SHALL WE FLY THE ATLANTIC?

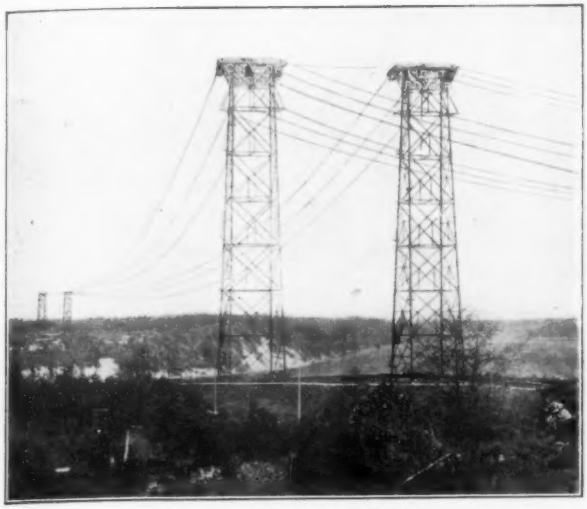
SHALL we—the general public—ever fly the Atlantic? Some of us will, undoubtedly, but how many and when, who can tell? Lindbergh, the beloved, says we shall, some day; so do Byrd, Chamberlin, and all of the men whose flying experience is such as to give great weight to their predictions.

Let it be noted carefully however, that when these men predict a coming transatlantic passenger service, they are careful to preface their forecast with many an "if" and "when."

An outstanding condition, which must be met if transatlantic passenger service is to be established, is a well-equipped, Atlantic, meteorological service. We say this without any disparagement of the excellent work of the Hydrographic Office of the Navy which, many years ago, arranged with the various steamship companies, and of course with its own ships, to supply the home office with data as to the direction and strength of the winds and the general atmospheric conditions; these data being published on the famous hydrographic charts of the office. The United States Weather Bureau also, although its duties are concerned mainly with weather conditions within or affecting the United States, has furnished the recent transatlantic fliers on request, with up-to-date information as to existing and probable future weather conditions on the Atlantic.

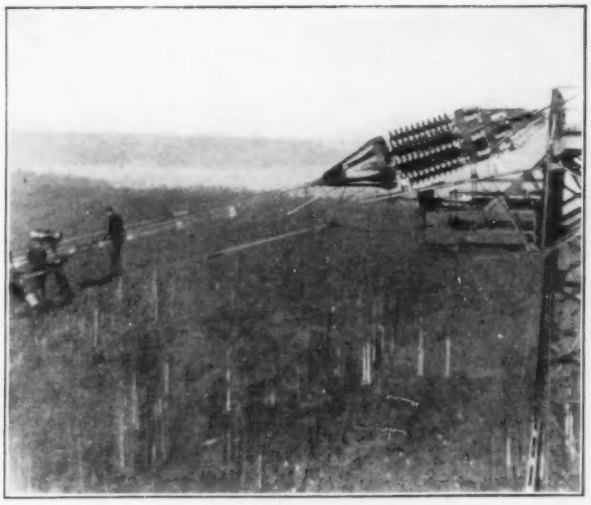
But before the traveling public is permitted to commit itself to a transatlantic airplane service, it will be necessary greatly to enlarge the present facilities for weather forecasting and render the forecasts so complete that, when a pilot launches his multi-motored plane and its precious freight out upon the vast reaches of the Atlantic, he will know with great certainty what kind of weather to expect and what detours he must make to avoid fog, snow, and sleet, or opposing winds that would use up his fuel supply before he reached American or European shores or some established landing between. Of such vital importance is this that we think the government would be justified in establishing, whenever the time is ripe for it, a special Atlantic meteorological office.

We are inclined to agree with Mr. Bellanca that a three-stage journey would be advisable, with stopping points at Newfoundland and the Azores. The planes would have to be large and of metal construction. Moreover, they will probably be monoplanes, developed along the line of the machine with which Commander Byrd flew to the pole and back. They will be driven by aircooled motors, varying in number according to the size of the plane.



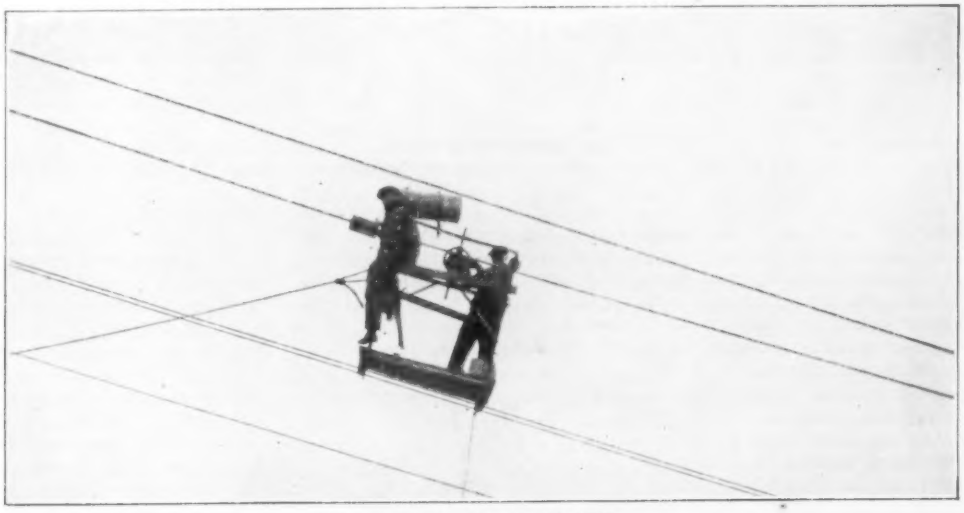
THE MILE-LONG SPAN

The seemingly impossible task of painting these slender steel cables was accomplished by the simple method described in the text and illustrated directly below



STARTING THE JOB

The sheaves supporting the car have been placed on one of the power cables and the task of applying the paint has been started. Note the insulators on the cables



CLIMBING AN UP GRADE

When approaching the end of a cable, the car is moved up the grade by means of a hand crank geared to a rubber-faced sheave, which bears on the cable, thus providing the necessary traction

Painting Mile-Long Cable Made Easy

Across the Narrows, a part of Puget Sound near Tacoma, Washington, stretch several strands of slender steel cable. These cables carry current which is destined to be used for light and power at distant points, and to keep them in good condition, it was recently found necessary to paint them. At first glance, such a proposition might seem impossible, but, after careful planning of every step, the paint was applied to the cables with little trouble and the job was completed without a mishap. The device which helped the painters immeasurably was a small car with special equipment, which was designed to be suspended from one of the cables and moved along it by hand power. The car was hung from two sheaves, one placed over each end of the framework of the car. A third sheave, with a rubber face, was placed in firm contact with the cable. This latter part was equipped with a brake and was geared to a hand crank. When traveling on a down grade, the brake was used to control the speed, and when on an up grade, the hand crank was used to provide the motive power. The method of applying the paint to the steel cables was a novel one. Instead of being brushed on by hand, it was automatically fed through special brushes. These consisted of two semi-cylindrical blocks of wood, each provided with bristles. These two half-cylinders were arranged to be clamped around the cable under treatment, and the paint was fed to them from the 15-gallon can placed over the framework of the car as shown in the above illustrations. As the car moved slowly along the cable, the paint was applied evenly to the metal surface. The car was raised to the top of the end tower on the anchor cables, from which point it was transferred to one of the power cables.

SCIENTISTS IN THEIR WORKING CLOTHES AT THE NEBRASKA SITE

Left to right: Glenn Jepson, paleontologist, Princeton University; Prof. Wm. K. Gregory, comparative anatomist, Columbia University; Prof. W. J. Sinclair, geologist and paleontologist, Princeton University; Albert Thomson, Chief Field Man, the American Museum of Natural History, leader of the expedition and discoverer of the oldest implements believed to have been made by ancient man; a student

New Trails of Ancient Man

Remarkable Finds of Ancestral Man Have Recently Been Made In Nebraska and Oklahoma

By HAROLD J. COOK

Honorary Curator, Colorado Museum of Natural History, Denver

IT has frequently been noted that great discoveries come in waves. Periods of quiescence are followed by periods of activity and advancement. We are now in an active stage of the recovery of the history of extremely ancient man in America.

Technically called paleoanthropology, the subject of early man is now attracting far wider interest than at any previous time; and the most important and striking of the evidences yet found, and some of the earliest known traces of the human race, have but recently been discovered in this country.

AS no such evidence of early man in America had been found which was not subject to question regarding its degree of antiquity, a school of skepticism has developed, which holds that really ancient man did not exist on this continent, and that man came to it only a few thousand years ago. Individuals have shown a tendency to become extremely dogmatic in their pronouncements in this direction, as if all the evidence were now in and the final decision rendered.

Fortunately, however, true science is not dogmatic nor is it typified by pronouncements of what "cannot be." Instead, it seeks through every possible avenue of information to assemble and coordinate all available facts, and to evaluate and interpret them without bias; and it fully realizes that opinions can neither alter nor replace facts, regardless of how unexpected they may be.

With this point of view let us consider the evidence offered by some very recent discoveries.

FINDING THE FAMOUS TOOTH

Prof. Abel of Vienna, and (right) the author, on the site of the earlier discovery of a tooth possibly human and more than a million years old

In 1908, Dr. W. D. Matthew of the American Museum of Natural History, New York City, and the writer discovered a series of ancient stream channel beds that now form gravel and sand ridges on the top of the watershed of a high divide between the North Platte and Niobrara Rivers in northwestern Nebraska, near the famous Agate Spring Fossil Quarries. These channel beds contain the fossil remains of an exceedingly rich and varied sub-tropical fauna, comparable in its numbers and variety to the great modern big game regions of Africa.

Expeditions have explored and dug in these beds each year since their discovery. Every year new evidence has been revealed, and some of it is of extraordinary interest. The former existence of a wide range of prehistoric life has been demonstrated, with many elements of far-reaching interest. A great variety of mammals, birds, reptiles, amphibians, fish and plant life is represented by the fossils, most of the animals being entirely new to science. New light has been thrown on climatic conditions in former geologic times, on intercontinental migrations of animal life, and on other matters of prehistoric interest.

WE find in those beds the first fossil evidence of true anthropoid primates ever found on the American Continent!

Of flesh eaters there is a most astonishing variety. Cat and dog relatives, from tiny to enormously large; and the relatives of modern mustelines such as mink, weasels, wolverine and their kind, were plentiful and of many kinds. Fossil horses in the three-toed

SOME OF THE FINDS

About a hundred objects such as those shown below, just as they were dug up and thrown out on the bank. In the background, the scientists' camp

POWER WAS EMPLOYED

A gasoline-driven air compresser furnished the means of blowing the earth away from the discovered objects without the usual danger of injuring them

stage are abundant. Several kinds of elephants (using the term broadly) are present, and all of them are types that lived before the mammoth. Numerous antelope and deer-like forms, some large and some tiny, are found. The first true bovids known to have reached America were discovered here.

Some of the families just mentioned show distinct relationships to Asiatic forms, and bear evidence of having migrated from that continent, over the land-bridge known to have existed at their time, connecting Asia with North America. Camels, great and small, were plentiful and of several kinds. Peccaries of various species, related to the little "musk-hogs" now living abundantly in places in northern Mexico, were there in numbers; also there have been found the very earliest known migrants from South America, small edentates—toothless mammals, like armadillos and ant-eaters—showing that a land connection had also been established with South America by this time, as mountains rose out of the ocean floor, forming the region along Central America.

Alligators big and little, and giant lizards several feet long, lived in Nebraska! Some of the birds show relationship to tropical species, further demonstrating the warm climate. A great variety of fossil wood, of many tree families, is preserved; and also fossil seeds and plant impressions. All of these things, both wood and bone, are completely turned into stone (silicified). The things mentioned constitute only a partial list of the great variety of life represented in these fossils.

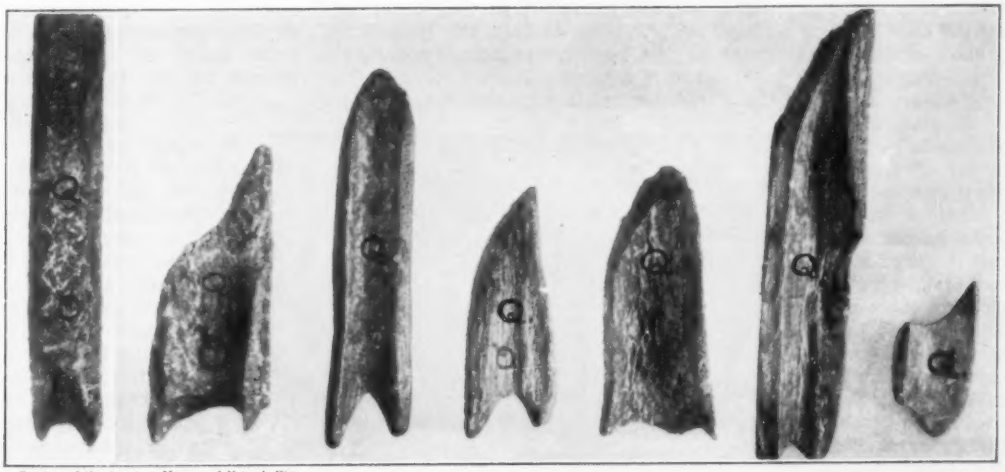
DURING the warm Pliocene period which preceded the glacial stages of Pleistocene time, this abundant fauna flourished; and with it has recently been found startling evidence of the presence of beings who must be closely akin to ancestral man!

While searching in the Snake Creek Beds (as we had named these channel beds for convenience), the writer found a single upper molar tooth, black and perfectly petrified, which appeared to be a fossil human molar! But, as these beds were admittedly hundreds of thousands of years older than the oldest known traces of humanity, we naturally felt very skeptical and incredulous, and felt that it must belong to some other unknown type of mammal, whose molar teeth simulated human teeth. However, repeated studies always brought us back to one point, that is, that the original possessor of the tooth *must* be related to ancestral anthropoid-humanoid stocks!

After keeping this tooth nearly five years in our private museum at Agate, Nebraska, hoping meanwhile that additional evidence might be secured, the writer decided to submit the specimen to Professor Henry Fairfield Osborn, President of the American Museum of Natural History, New York, as the man of all Americans best equipped to make certain and accurate comparisons and determine its real relationships. This was done; and Professor Osborn verified this determination and announced the discovery, recording it as the first occurrence of anthropoid - humanoid stocks to reach America.

Following this, further expeditions were sent out by the American Museum, and many interesting and important discoveries were made. Unfortunately, the spot where the original find was made was on the land of a ranchman who took no interest and showed no intelligent understanding of the importance of such discoveries; and he arbitrarily ordered all work stopped on his premises!

This misfortune proved to be a blessing in disguise. Mr. Albert



Courtesy of the American Museum of Natural History

TYPICAL SAMPLES OF THE OBJECTS FOUND IN WESTERN NEBRASKA

Of similar objects, literally thousands were unearthed. Originally bone, they are now very thoroughly fossilized and ring like stone. They have close counterparts in implements discovered in the cliff dwellings

A COMPARISON

The bone implement in the center is from an Aztec collection. The others are from the Nebraska site

Thompson, Chief Field Man and Preparator of the American Museum, finding himself barred from this "Land of Promise," moved across the fence to an adjoining ranch, whose owners took great interest in the work. Here, in a most unpromising location, his keen eye located evidence that, of its kind, is one of the great discoveries having to do with early man. In undisturbed, original deposits, associated with the wonderful array of Pliocene fossil animal life described above, he found evidence of the first culture known to have been developed by the human race, and the oldest trace of humanity, by hundreds of thousands of years!

THE evidence seems to indicate that these beings made artifacts (implements) of the green bone of the contemporaneous animals. Some of the bones are drilled; many are shaped and sharpened in various forms; while others must have been used for pounding. Many show evidence of artificial abrasion of different types.

Critical preliminary studies of these first human implements or tools has been made by Prof. Osborn and Mr. Thompson. This discovery is opening a whole new chapter in the history of the human race, and carrying the age of Man, capable of tool-making, vastly farther back than most students of the subject have anticipated. Especially was it unexpected to find such evidence in America!

Let us now turn to another piece of evidence that ancient man existed in America—one from a locality hundreds of miles south of the one just described. In the November, 1926, issue of the SCIENTIFIC AMERICAN the writer published an article on primitive man in America. In December following the publication of this article, the editor of the SCIENTIFIC AMERICAN received a letter from Dr. F. G. Priestley of Frederick, Oklahoma, stating that he had read the article, and that in his opinion interesting scientific evidence existed near his community. His letter indicated the probability that an important discovery might be made; and Mr. Albert G. Ingalls, Associate Editor of the SCIENTIFIC AMERICAN, forwarded the letter to the writer, suggesting that we might be interested in looking into the possibilities.

Early in January, the writer went to Denver, Colorado, and called these letters to the attention of Director J. D. Figgins of the Colorado Museum of Natural History. Arrangements to investigate the evidence were immediately completed. Late in January, the writer drove Mr. Figgins from Denver, through New Mexico and Texas, to Frederick, Oklahoma, and found there some of the most important and ancient evidence of early man known in America.

A MILE north of Frederick lies the highest hill in the region. This hill is really the end of a long rambling ridge, running north, away toward the Wichita Mountains some thirty miles distant. This hill or ridge is composed of coarse sand and gravels which lie directly on an old worn and eroded face of Permian Period Red Beds. About a mile north of town, Mr. A. H. Holloman owns and operates a commercial sand and gravel pit; and it was during the work of excavating this large pit that the evidence in question came to light.

The geological evidence shows that the sand and gravel had once been carried in and bedded in its present position in rapidly moving water; and that the top of this, the highest hill in the region, was actually once the bed of a large prehistoric river! Considering the fact that the top of the hill is now over one hundred feet above the surrounding valleys immediately joining, and some two hundred and eighty feet higher than the present Red River which now drains the region a few miles away, it becomes obvious at once that this is by no possibility a recent river bed!

Evidently, then, a large river valley has become essentially inverted through erosion, so that the part that was the lowest has become the highest. This inversion was brought about by the hard granitic sands and gravels which flood waters had swept into the channel. These had become firmly bedded and "set," so that they were far more resistant to erosion than the surrounding Red Beds in which the old valley had first been cut out. Endlessly repeated rains and winds, freezing and thawing, and melting snows, in their ceaseless progressive destructive action, wore away the softer Red Beds, while the gravels held their own, resisting removal. Gradually the whole surface of the surrounding region wore down until banks no longer existed high enough to hold the stream to its bed.

IN OKLAHOMA

The Holloman gravel pit at Frederick, where other new evidence of ancient man in America was unearthed

At this point, a transition stage set in, during which the old valley no longer carried the main river, but its old bed was still subject to periodic flood-plain overflow. Finally this ceased, as the surrounding region eroded more deeply, and the stream migrated away as lower channels were formed in the softer flanking beds.

A third stage now set in. Winds in dry periods lodged dust on top of the old flood-plain sediments, leaving a thin, typical aeolian or wind-deposited bed. The face of the Holloman gravel pits bears evidence of just this

Courtesy of the American Museum of Natural History

MORE OF THE NEBRASKA DISCOVERIES

Fossilized bone objects which bear close resemblance to beads made comparatively recently by American Indians

sequence of deposits, as shown below.

On the irregular Red Bed floor, there lies about seven to fifteen feet of cross-bedded, river channel bed gravels and sands, coarsest at the bottom, and in part cemented into hard, dense rock. Overlying this are some five to seven feet of flood plain wash, coarse and fine. On this lie about three to five feet of aeolian silt and prairie soil. For convenience, we may call these beds A, B, and C, in the sequence cited above in the order of their deposition. (See drawing.)

THE old river bed that forms the cap of the hill is roughly half a mile wide, and many miles long. Buried in undisturbed deposits of this old stream bed, down in the lower "Bed A," and associated with the bones of many extinct and typical Pleistocene (ice age) animals, were found stone implements made by man!

Strangely enough, these implements show a degree of culture closely comparable with that of the modern nomadic plains Indians. This partly confirms and makes more probable the suggestion made by the writer in the November, 1926, issue of the SCIENTIFIC AMERICAN, namely, that possibly such Indians had changed but little in a long period of time in America. Failure to recognize such a possibility has probably been the chief cause of the failure of able authorities to realize the antiquity of man in America.

It now appears to me quite probable that these very early people *were* closely comparable in most ways to our modern Indian, structurally as well as in culture; and if so, this would account for the errors in interpretation as to man's antiquity in America, fallen into by some talented scholars.

The animals found and identified in Bed A with the artifacts are undoubtedly but a small fraction of the fauna of the time. Three types of elephant occur, two of which are of the type popularly known as mammoths. The other is a more primitive mastodon-like form (to stick to common names). The elephants of America were all originally migrants from Asia, although they had been well established a long time in America before Pleistocene times, having first come to America about Middle Miocene time. Three genera of edentates occur, all originally migrants from South America. Two are the large ground sloths, Mylodon and Megalonyx, distant relatives of the little tree-dwellers of South America of today. The third, Glyptodon, is a peculiar fellow with a back armor or carapace that strongly reminds one of a turtle shell, but of very large size. Two species of camel, and at least three species of fossil horse occur. All of the latter are of our modern genus *Equus*, but of species that were abundant in Pleistocene times.

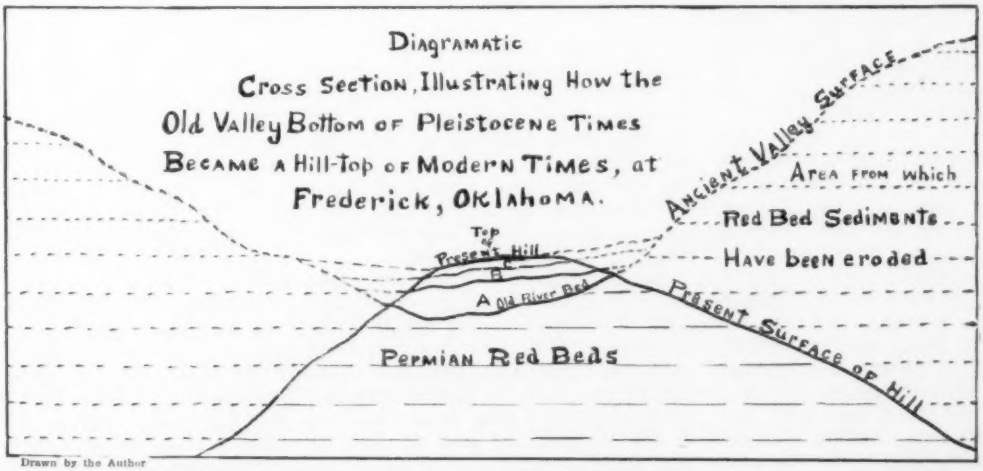
DR. F. G. PRIESTLEY

Last December Dr. Priestley found evidence of very ancient man, near his home at Frederick, Oklahoma. He at once reported it to the SCIENTIFIC AMERICAN *which turned it over to Mr. Cook, the author, for investigation*

Regarding the time required to accomplish the surface erosion obviously brought about since those animals and men lived in Oklahoma, we may get a general idea from the following facts. They are taken from careful records kept at the mouth of the Mississippi River, on the solid or mud content of its waters. Careful computations based on these studies indicate that about one inch in 750 years is being removed from the whole face of the country drained by the Mississippi river system from the Alleghenies to the Rocky mountains. That amount is being removed under the present average precipitation, climatic conditions and altitude factors. We know, however, that these conditions are variable, and that they have differed widely from time to time in the past. Nevertheless, this information provides a rough basis for calculation. At this rate, it takes 9,000 years to remove one foot from the surface of the region. To cut the surface the depth of the local valleys would therefore take about 900,000 years; and to develop the drainage down to the present Red River level, 280 feet below, would require the appalling time of 2,520,000 years.

THIS is undoubtedly excessive. We know that during part of Pleistocene time erosion was much more rapid than now, and we are possibly justified in cutting that estimate in half on that basis. Then, to allow for other possible errors and to be conservative, if we cut that figure in two twice more, we will still have indicated an astonishing lapse of time *since* that stream ran where the hill-top now is!

Geologically speaking, the 365,000 years indicated by these figures is not long. The geology, the stratigraphy, and the animal remains found, all confirm the age of these beds. While not as old as the Pliocene culture from Nebraska, described above, I believe this Frederick, Oklahoma, discovery furnishes the most conclusive evidence of Glacial Age man yet found in America.



HOW A FORMER STREAM BED CAME LATER TO FIND ITSELF THE CREST OF A HILL

This is described in detail in the text. Such a peculiar sequence of events is familiar to geologists

Cipher Messages of the Stars

How the Modern Spectroscope Reveals Secrets to the Astrophysicist

By HENRY NORRIS RUSSELL, Ph.D.
Chairman of the Department of Astronomy and Director of the Observatory, Princeton University
Research Associate, Mt. Wilson Observatory of the Carnegie Institution

A YEAR or so ago we had occasion to speak of some of the dreams of astronomers, and how they have come—or may come—true; but they were not all told. The student of the spectrum has dreams of his own. He realizes, as his forebears have for nearly two generations, that the spectrum which we obtain by sending the light of a star through a prism is not the meaningless number of lines that it appears to the uninitiated glance; it is a series of cipher messages from the star.

Like some human messages in cipher, the message of the spectrum is effectively concealed from the casual glance. Just as some messages written in "invisible ink" can be recognized only when the sheet on which they are penned is examined in light of the right color, so the very existence of the message of the spectrum is revealed only when the star's light is spread out by a suitable instrument which separates the innumerable varieties of light of which it is composed, and enables us to perceive that some are faint or absent.

The photographic plate, behind the slit, lenses and prism of the spectroscope, enables the astronomer, then, to do what the military intelligence officer does by his zealously guarded devices—to detect and copy the concealed message. But when the message is in our hands, it must be decoded and interpreted, and this takes still greater skill.

THE main outlines of the spectroscopic code have been known for sixty years. Each chemical element—or for that matter, each separate chemical compound, if it can exist without decomposition on the star—gives us its own characteristic pattern of lines, which reveal its presence. A qualitative analysis, as the chemist would call it, of the sun and the stars has therefore been practical for many years, and we have been able say, too, in a rough way, that the elements that give strong lines in the sun must be abundant there, and that those which give only faint lines are probably present in relatively small quantities.

But the chemist is not satisfied with a qualitative analysis; he makes it quantitative, and finds what percentages of the various elements are present in his samples. Can we do the same for the stars? And can we get any information from the spectrum concerning the pressure and the temperature in the atmosphere of a star, when the spectral lines are formed? The work of a host of workers, theoretical and practical, in the last ten years has shown us that there is far more to be read from our stellar spectra than we once supposed. Keeping up our analogy, we may say that the older methods told us what letters corresponded to the symbols of our cipher, and enabled us to read the message in pronounceable words, to teli in what language it was, and get its superficial significance. Now we can go behind this and find out a great deal about the circumstances under which the message was written, and the fuller meaning of its phraseology.

THE LABORATORY IN PASADENA

In addition to the great group of astronomical instruments on Mt. Wilson, near Pasadena, a splendidly equipped laboratory and office is maintained in the city itself. Here some invaluable collateral research in astrophysics has been performed by the Mt. Wilson Observatory Staff

We know quite well what changes happen inside the atoms when the light of some particular spectral line is absorbed; and, if we know what the atoms of half a dozen kinds are doing in a star's atmosphere, we can work out pretty good determinations of the temperature and pressure of that atmosphere.

Surprising, but well established results have already been attained. For example, we know that the atmosphere of the sun is so rarefied that all its hundreds of miles of depth, compressed to the density of common air, would make a layer not more than a foot thick, and that the atmosphere of many of the stars must be still more tenuous.

ONE of the dreams of the spectroscopist has then been largely realized. Our means of interpretation of these cipher messages are advanced beyond even the hopes of twenty years ago.

But the advance has led to new observational demands. Most stellar spectra—especially those of stars redder than the sun—are full of lines—they are like Merlin's book of magic, with its margins written over "with comment, densest condensation," so that only the master's eyes could read the charm. Even for the sun itself, where we have floods of light, and may use the most powerful instruments that can be built, there are hundreds of lines that are "blends" of two or more components, due usually to quite different substances, which are so close together that our greatest resolving power cannot separate them.

In the older days, when we wanted only to know whether there were iron, nickel or calcium in the sun, this did not matter much. If our initial line was confused by a blend, we could usually find plenty of others which were not, and which sufficed to prove the presence of the element. But our present problems demand a careful, detailed study of the position and the intensity of each individual line, and we cannot turn to one to tell us what is concealed by blending in another case.

It is therefore of prime importance now to photograph our spectra on the largest practicable scale. The spectrum of a star like Arcturus is so crammed with lines that if we take the finest photographs of the past generation, showing a spectrum three inches long, with hundreds of lines visible, the great majority of these "lines" are really blends of two, three

or four stellar lines, too close together to be separated on this scale.

Professor Rowland, in his great work at Johns Hopkins thirty years ago, prepared a map of the solar spectrum enlarged from his original photographs which, if the sheets were placed end to end would make the visible spectrum more than forty feet long. With this great scale, much—although not all—of the difficulties disappeared.

The stellar spectroscopist, for many years, has dreamed of having spectra "on the scale of Rowland's map." His dream has not quite come true, but it is nearer realization than he ever dared to hope. To make it come true, even in fact, demands two things. First, the feeble light of the star must be concentrated by a great telescope, so that as much as possible of it may be fed into the slit of his spectroscope. Secondly, the spectroscope itself must be large and powerful. A small instrument, however perfectly constructed, will not suffice. It is well known to students of optics that just as a small object-glass can never give separate images of a close pair of stars, a small prism cannot resolve two closely neighboring spectral lines. In both cases the properties of the light-waves themselves set the limit.

TO get the spectra of which we dream, we must then have a huge telescope and a big spectroscope. The hundred-inch reflector satisfies the first need, and, in designing it, an auxiliary mirror was provided which may be set to reflect the light down towards the south pole of the heavens, so that, as the telescope follows a star all night long, its light is delivered always at the same point. Here it enters a spectroscope which is fixed in position, thus avoiding many complications. The lenses of the spectroscope are of fifteen feet focal length, and the prisms eight inches and more on a side. There are two of them, with a mirror behind to send the light back through them, and the lens again, so that the power of four prisms can be realized.

The elementary student thinks of a spectroscope as a portable instrument, easily carried from one place to another. Even the experienced laboratory worker thinks of its prisms as small, although costly, optical parts, and when he hears of a case placed around the prisms to protect them from changes of temperature, his idea is naturally of something perhaps as big as a waste basket, at the most. But this spectroscope is different. It requires, like others, to have its prisms kept at a constant temperature—for otherwise the spectral lines would shift on the plate during the long exposures, and spoil the photographs—and this case must be electrically heated, by devices connected with a delicate thermostat, so that, if the temperature falls by a hundreth of a degree or so, heat will be turned on to warm it up again. But this time the prism case is a huge wooden box perhaps seven feet square, with doors that open almost wide enough to let in an automobile.

To put the lens and prisms in place is strenuous work, for these valuable affairs are no light load. One of the great prisms, with its mounting, must weigh well on to a hundred pounds, and this has to be held up as high as a man's head, and its carriage slipped into place while the bolts that hold it are set and screwed home. One man alone could do nothing, and it is a hard job for two. A few days ago, the writer saw the thing done by three men—who had to be as active physically as they were competent technically, and all three while at their work were inside the constant-temperature box of the instrument!

When the apparatus was finally assembled, various adjustments had to be made (for focus and the like) and a good day's work had been put in before the spectroscope was ready to receive starlight in the evening.

Then came the final test—seven hours' exposure upon Arcturus—the observers sitting in a darkened room below the observatory floor, watching through an eyepiece the slit of the instrument, and manipulating the electrical controls so that the star's light was kept steadily going where it was needed. The end crowned the work. The plates, developed the next day, showed a spectrum, running from the violet almost to the green, and twenty inches long. The same region, on Rowland's published map, would be five or six times as extensive; but these have been enlarged from the original photographs, and if the same should be done for the star, the dream of the elder workers would be very nearly true.

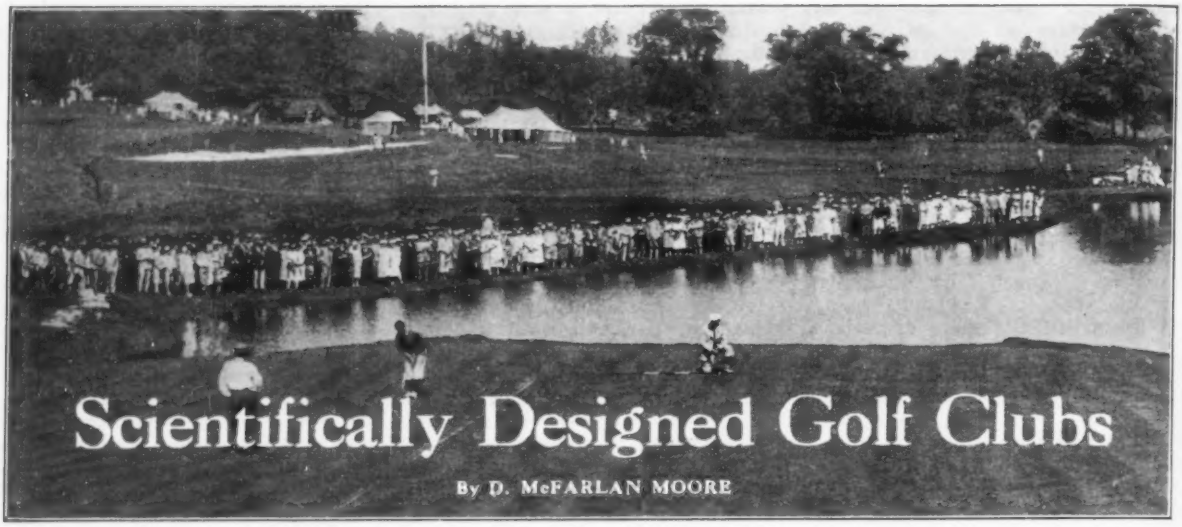
Only the brightest stars can be observed with this great power, but with one prism working instead of two, anything brighter than the third magnitude is accessible. This means that stars showing almost all the principal types of spectrum may be studied. A single plate, the result of a night's work, may show far more than a thousand lines. The measurement of them, and the working out of the results, is enough to keep a good man busy for weeks. And so the men whose dreams have come true are happy—they have the chance for more of the work that men like Michelson find "such good fun." When it is through, we will know far more about the conditions which prevail in the stars than we do now. But the satisfaction in the results will not equal the pleasure in the search for the fortunate few who can pursue it.

THE fainter stars, which cannot be attacked with these spectroscopes, are studied with small ones—at the other extreme comes an affair that gives a spectrum only an eighth of an inch long—and we can get an intelligible, although of course not a detailed, spectral message from a star that sends us only a millionth as much light as Vega.

Working on the fainter stars has its incidents too. Not ten days ago the writer found one of his colleagues observing upon a faint star so far to the south in Centaurus that the telescope tube seemed almost horizontal. "Come along up," said he. Coming up involved climbing out along the huge frame of the instrument, up a sort of ladder fixed on one side of the huge "fork" which holds the great tube, with the concrete floor twenty feet below, and then swinging out upon the back of the great tube, where the two of us sat—as if on the back of some monster far larger than an elephant—and discussed the universe in the intervals of controlling the instrument.

A CODE MESSAGE WHICH REVEALS A WORLD OF FACTS TO THE PHYSICIST

Various elements in the gaseous layers surrounding the stars absorb the light of certain wavelengths. This light therefore fails to register in the spectrogram, because it simply is not there—it did arrive from the star. The dark lines that result tell the astrophysict which elements in the star's atmosphere have stopped the light, because he has made similar experiments on artificial light, working in laboratories like the one on the opposite page



Scientifically Designed Golf Clubs

By D. McFARLAN MOORE

WHEN I handled golf clubs for the first time a good many years ago, I immediately complained that they were not properly designed. That is, a golf club is an instrument for striking a ball and as such it should be formed strictly in accordance with the laws of mechanics. But this is not the case with what is today accepted as a typical set of golf clubs. They could very properly be described as glorified "crooked sticks"—such as evidently were used by the first Scotch players. [One exception to this is what is known as the Schenectady putter. The Editor.]

If a mechanical engineer were asked to design an automatic machine for striking a ball with a diameter of 1.62 inches and a weight of 1.62 ounces, he would be considered a very poor engineer indeed if he placed the point of striking one and one-half inches off center. Yet an ordinary driver, for example, is a machine, or rather a tool, that has just such poor design incorporated in it.

Golf experts have simply learned after much practice the trick of doing "fairly well," with poor tools. If a player now averages about "100" he can easily reduce it to less than "90," simply by using properly designed clubs. Or a beginner can break a "100" with less than half of the practice or expensive lessons now required.

FIGURE 1 is a photograph of the new and properly designed brassie. It is not "off center" at all. It obeys the fundamental laws of mechanics that should be rigidly applied to the design of all clubs of a set; that is, the axis of the shaft must be intersected by the prolongation of the diameter of the ball that points in the direction in which the ball is to travel. Figure 2 illustrates this new principle in elevation. Figure 3 illustrates an ordinary club in the same way. The upper portion of these two figures view the golf ball and club from the direction in which the ball is to go and the lower portions view the ball and club from above.

Common sense and principles of mechanics tell one how extremely defective in principle is the old design as compared with the new. Referring first to Figure 3, it is obvious that the smaller the angle x (which governs the "lie" of the club) the greater the tendency to reduce, at the moment of impact, the angle y; or in other words, to cause the club to twist backwards in the hands. Now referring to Figure 2, we find that angle x is the same, but there is no angle y; and therefore, that greatest bugaboo to the beginner of golf is entirely eliminated.

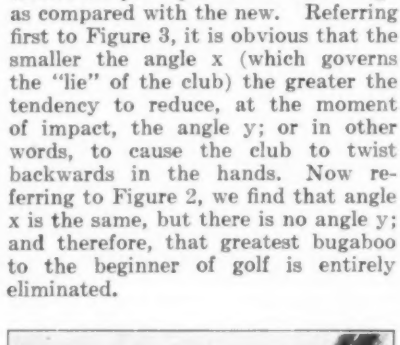


FIGURE 1

In this improved brassie the ball is struck with the face of the club at a point where the axis of the shaft crosses the center of the club face, thus realizing the greatest possible efficiency from the stroke

It also is clear now why professional instructors have told us to try to get the habit of unconsciously tightening our grip just before the club hits the ball. Experienced golfers, when getting accustomed to these new clubs, will need to forget this. With the new design this admonition is unnecessary—the disturbing twist has disappeared and the ball is struck so "sweet and clean" that the very sound is exhilarating. When using the old clubs, the very laws of mechanics determine that the pressure of the stationary ball must tend very decidedly to make the shaft of the club revolve backwards in the hands.

IF the angle x was less or eliminated —for example with the shaft straight up, and at a right angle to the ground—the revolving action would be at a maximum. But since you can drive the ball better when standing further away from it, the angle x is necessary and the resultant tendency to a rotary motion in your hands is still present.

But if the shaft of the club is attached to the head in accordance with the principle shown in Figure 2, then the very undesirable and unscientific twisting motion is entirely eliminated, and the club comes as close to scientific design as it is possible to make it.

The mechanical motion is pure and the stroke is almost necessarily clean. The distance which the ball can be driven is much increased and the possible accuracy in direction is far greater.

Although mentally convinced many years ago that such a club design was correct, it was only at a comparatively recent date that I had clubs constructed which very decisively proved their superiority. The first step was to remodel an ordinary brassie as shown

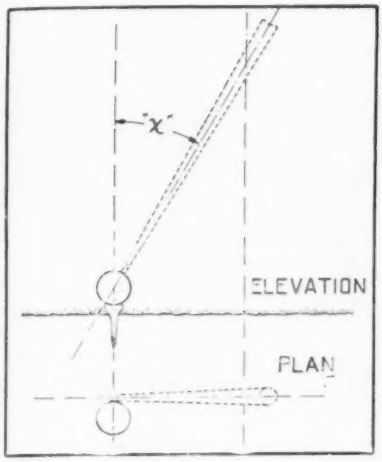


FIGURE 2

Showing how the brassie illustrated in Figure 1 meets the surface of the ball

in Figure 1 on the opposite page.

This was done by retaining the angle of lie x, but moving the axis of the shaft 1½ inches to the left, when viewed from the front. The old goose-neck stepping of the shaft was sawed off. At its lower end the new shaft axis passes directly behind the point on the face of the club where the spherical surface of the ball first meets it.

THERE is no tortion factor to be considered with this new and improved line of clubs but there is a definite inter-relation between each of the clubs of a set as regards length, total weight, balance (head weight), resilience, grip, lie angles, face-loft angles, et cetera. They are the easiest swinging and longest hitting clubs, because there is no uncertain feeling at the beginning of the stroke, and at the end no violent vibration of the club in the hands. With them, every ounce of effective force can be made to count in producing the highest club-head speed just as it approaches the unsuspecting ball.

The muscles of the hands and wrists can do their best, because no strength is lost in attempting to overcome that uncomfortable and wholly unnecessary twisting factor.

When addressing the ball, the feel of the brassie shown in Figure 1 is remarkably quieting. Both its toe and heel avoid going into the air and its sole is settled. Also, one most naturally takes the correct grip on the circumference of the shaft. That is, there is no uncertainty as to whether the under knuckles be revolved to the right or left and no desire to change the angle of the club's face. A club-inspired quiet confidence assists greatly in avoiding errors in turning or changing the angle of lie during the up or down stroke.

Even the beginner generally escapes the humiliating feeling following the missing of the ball altogether, or of dubbing it, and soon finds himself making consistent rounds.

Due to the really perfect balance now possible, the "whip" of the shaft is distinct and most of the best known troubles that beset golfers, including slicing, hooking or pulling, topping, et cetera, disappear.

THE essence of golf is distance and direction. Far greater accuracy in sending the ball exactly in the direction desired is now possible because the very disquieting factor of twisting is eliminated.

The design of these new clubs permits of far greater strength and better workmanship. They will not only improve your game, but very greatly enlarge your enjoyment because of the absence of perplexing failures.

Golf is a game of delicately adjusted details that have rightly been considered of great importance, but it seems almost astounding that the factor of such prime importance as changing the fundamental principles of golf clubs has not been given proper attention before.

The diameter of the shaft is often made large in clubs of so-called standard design, to help the grip withstand the twist, but it has also been said the less the wood the better, and even the width of the face of the club can be less because less leeway for error is needed as confidence becomes greater.

In principle, at least, most of the foregoing is directly applicable also to the irons. The present-day st ndard

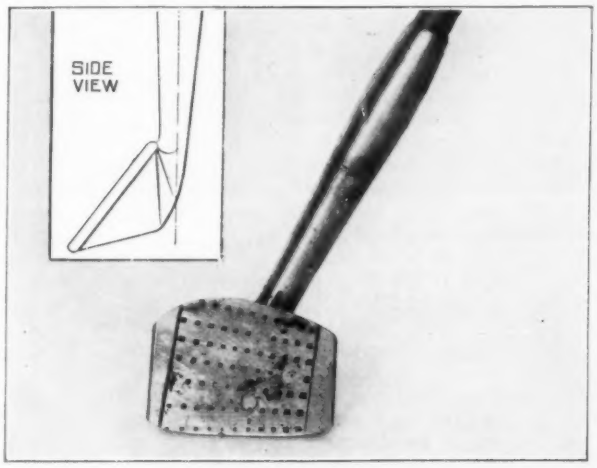


FIGURE 4

A modified mashie, in which the head is not off center. The insert shows a side view of this same club head

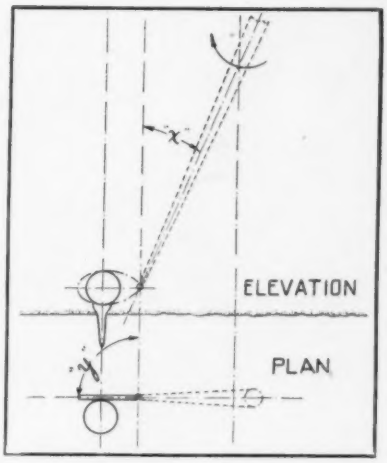


FIGURE 3

A standard "iron" tends to twist in the hands as shown by the curved arrow

line are all wrong. They sin against the laws of mechanics even more than the wooden clubs, such as the driver and brassie.

An ordinary mid-iron is as much as two inches off center. Figure 4 is a photograph of a very much modified mashie—yet the angle of lie is the same and so is the face-loft angle. When properly used, a mashie always sacrifices distance for accuracy in direction, which nevertheless heretofore required much practice. But with this new mashie the hit is definite. It is like a hammer that hits the nail on the head, not with an off-center blow. If you imagine trying to drive a nail by hitting the nail with only a two-inch projection out of the side of the head of the hammer, you are picturing the action of an ordinary mashie.

ON trial, the mashie, modified almost beyond recognition (Figure 4), proved very satisfactory and led the way to the improved design shown in Figures 5 and 6. By increasing the face-angle from the 65 degrees of the mid-iron and changing the lie-angle and shaft length, the driving iron, cleek, putter, et cetera, are made. And by decreasing the face angle and changing the lie-angle and shaft length, the mashie iron, the mashie, niblick, et cetera, are made. Due to the greater hitting accuracy now possible, there is no need for a greater face width than the two-and-one-half inches shown. Neither will professional "turf digging" be nearly so much indulged in as at present, thus also dispensing with the unpleasant and expensive feature of roughened fairways.

The balanced face of the club shown

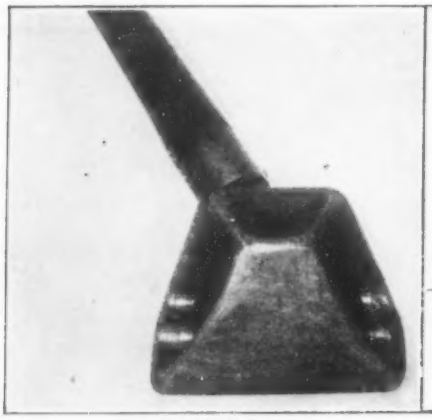
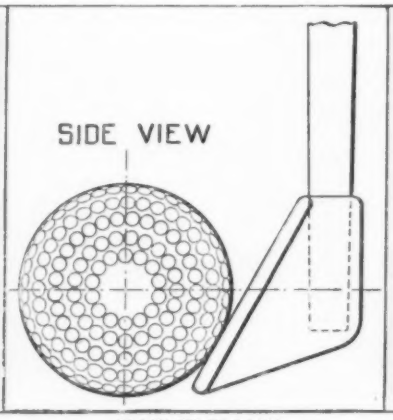


FIGURE 5

A rear view of the "iron" which is again illustrated in Figure 6 at the right



HOW IT WORKS

This shows how the club is brought into contact with the ball's surface

FIGURE 6

The face of one of the newly designed "irons" which can be made in any form

in Figure 6 is an improvement over the very irregular outline of the face of an ordinary iron. In fact, it is simply a fast-moving uniform inclined plane that picks up the ball. Figure 5 is a rear view of the club shown in Figure 6. The transverse holes were made simply to obtain the correct weight. The metal of this head is so distributed that there is no retardation in properly "carrying through" the stroke. The heavier the head of a club, the more difficult it is to control its direction during the downward swing so that the mechanical center of its face will strike opposite the ball's center.

Face indentations can be greatly varied, but the simple parallel grooves shown covering the entire surface have proved adequate.

The longitudinal axis of the shaft must not only intersect the vertical center of the club's face, but must do this at the proper height; that is, at the vertical center of the club's face which is opposite the ball's center. This theory is therefore very different from that advanced for what is today generally accepted as an ordinary set of golf clubs. In the latter case, the shaft is considered as a mere tool to "throw the head of the club at the ball."

The stored energy of the head, which is equal to the product of its mass times its velocity, is supposed to be solely responsible for changing the condition of the ball from a state of rest to rapid motion. That is, the function of the muscles of the arms is not supposed to aid in suddenly pushing the ball forward but merely to produce a rapid speed for the club's head just before the moment of contact. But the average individual requires long practice to reach such a stage of efficiency. However, if to this theory there is added a club design that permits the muscles of the arms to aid directly in urging the ball forward without ruining its direction, a distinct advantage has been gained. That is, with the improved clubs in which the centers of gravity of the heads are in alignment with the ball at the movement of impact, it is possible for a new player to get a reasonable distance and good direction long before he has mastered high club-head velocity.

The face corrugations consist solely of concentric circles, and when the ball is struck, the center of the club head is exactly opposite the center of the ball. The diameter of the head is a little less than the diameter of the ball. Also, the perfectly flat and uniform face enables the player, when viewing it from above, to most easily place it at right angles to the line reaching to the center of the cup, so that as regards direction it makes it the most accurate of all putters.

When a ball is struck with all ordinary clubs, there is a considerable complexity of resultant forces, angles and planes which all affect the ball's ultimate direction, but with this simple disk club, the resultant action is most direct.

A complete set of "center-line clubs" constitutes a decided and radical departure from the long accepted and traditional form of golf clubs, and therefore it is to be expected that some opposition will develop before their use will be universally sanctioned. But the "urge to win" in golf is so great that scientifically correct clubs will fill a large and pressing demand.

FIGURE 7

An "iron" of the straight-line type, in which the face is nearly perpendicular

FIGURE 7 is a photograph of a straight-line club of the same general type, but its face is more nearly perpendicular to gain greater distance, and it was first machined as a disk. Then the lower segment was removed so that the center of the inclined face would be the same height above the ground as the center of the ball.

Figure 8 shows a putter. Some might describe it as an abbreviated croquet mallet with modifications. Perhaps it is the simplest of golf clubs. It should be noted that besides being a straight-line club, there is no "lie angle" as the term is generally used, because both of the striking faces are parallel to the shaft axis. Nevertheless, since the faces (either one can be used) are circular, the angle of the shaft axis to the ground can be anything the player finds best.

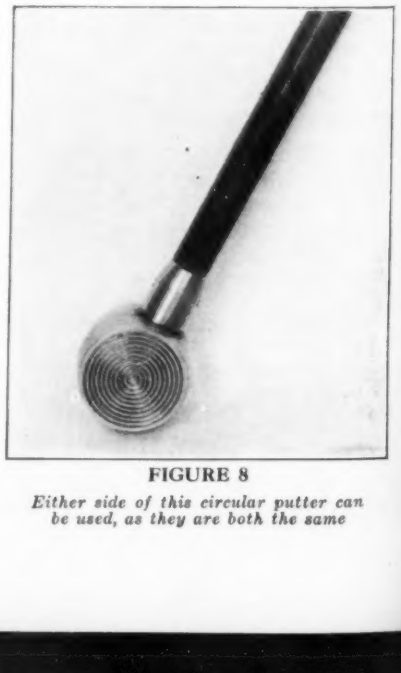
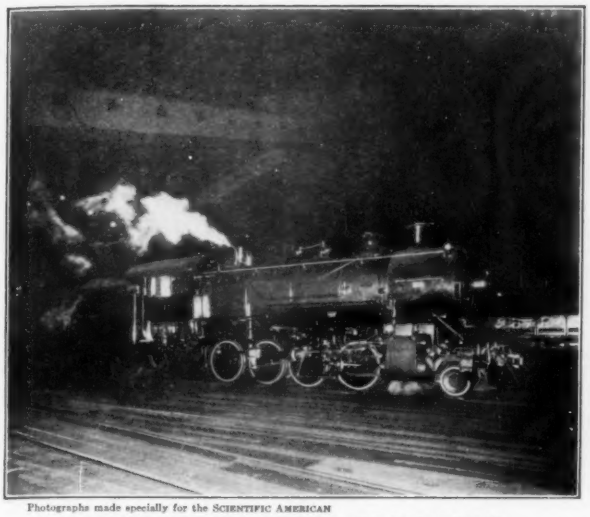


FIGURE 8

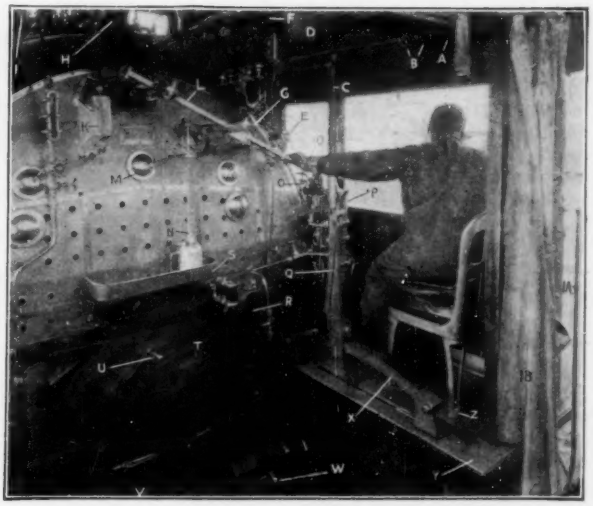
Either side of this circular putter can be used, as they are both the same



Photographs made specially for the SCIENTIFIC AMERICAN

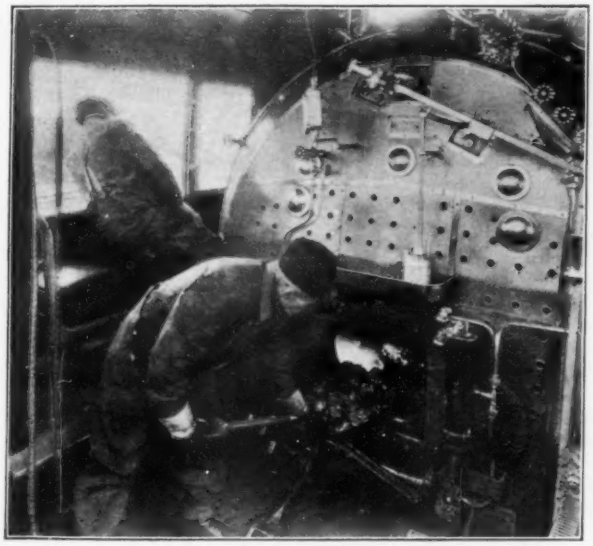
ELECTRICALLY LIGHTED LOCOMOTIVE

The well-known "Ford efficiency" is applied in locomotive design. This night photograph shows one of the new types



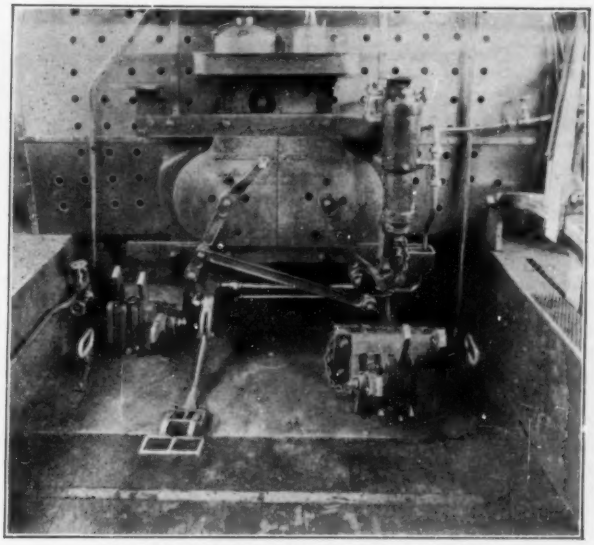
ENGINEER AT THE THROTTLE

This view of the upper part of the cab shows the engineer's controls. Everything is as convenient as in an automobile



STOKING UP DURING A RUN

The fireman shovels coal and keeps the water at the proper level. In freight trains, the head brakeman rides in cab



THE FURNACE END OF THE BOILER

The door in the center can be opened by hand, by compressed air or by foot when the fireman has a shovelful of coal

Everyman's Locomotive

During a recent visit to part of the Ford establishment, usually called the River Rouge Plant, we were attracted by the many locomotives which we saw. Our curiosity was soon satisfied, for near the great blast furnaces we found a completely equipped locomotive shop. We do not say factory, for we do not wish to give the idea that the Ford Motor Company is making locomotives for sale. They do, however, make them for their own use on the rails of the Detroit, Toledo and Ironton Railroad Company. We believe certain parts are made elsewhere, but they are few in number and most of the work of production is carried on in this shop. The locomotive required for the service of this railroad is not of the very largest type so it might be called "everyman's locomotive." Two things about the locomotives are very pronounced. The first is the mass of nickel plating, for Mr. Ford is very partial to having everything spick and span and his idea is a good one for he argues that if the nickel-plated part is bright, it is clean. The next point is the fact that the engine is electrically lighted at all the points where troubles usually occur. Through the courtesy of Mr. L. R. Williams, Superintendent of the locomotive shop of the Detroit, Toledo and Ironton Railroad Company, we are enabled to present some "close ups" of the cab which has such a fascination for almost everyone. Mr. Williams has marked the various parts and here is his list: A—headlight switch; B—bright or dim switch for headlight; C—whistle lever; D—air gage; E—gage cocks; F—lubricator; G—gage-cock dripper; H—turret box; I—top water-glass cock; J—water-glass; K—water-glass light; L—throttle lever; M—washout cover plate; N—engine oil can; O—independent brake valve; P—automatic brake valve; Q—reverse lever; R—fire-door air cylinder; S—drip pan; T—fire door; U—hand operating lever for fire door; V—foot operating lever for fire door; W—grate-shaker lever; X—reverse-lever quadrant; Y—aluminum floor; Z—aluminum chair for the engineer; 1A—grab handle for use when mounting cab; 1B—cab curtain.

Are Athletes Machines?

Newly Invented Electric Timing Apparatus Reveals the Science in Running

By A. V. HILL

Foulerton Research Professor of the Royal Society, London: Nobel Prizeman in Medicine

IN a previous article in this journal (April 1926, page 224) I suggested that an electrical method of timing runners, not only over the whole extent but throughout the course of a race, might be of considerable interest, not only to athletes and the sport-loving public but to those who are studying athletics from the scientific standpoint. During the tenure of a non-resident lectureship in chemistry at Cornell University I have recently had an opportunity of testing this suggestion in practice, with results which have greatly exceeded my expectations.

The apparatus employed is shown in Figure 4. It consists of a series of coils placed parallel to the track at measured intervals. Each coil consists of 200 turns of insulated copper wire, Number 26, the coils being connected in series to a Moll moving-coil, mirror galvanometer of very short period (0.8 second), placed in a room in the pavilion. The movements of this instrument, adjusted for aperiodicity, are recorded photographically on moving bromide paper in a camera of the type constructed by the Cambridge Instrument Company for use with the electrocardiograph. Time marks are made by a metronome or pendulum which cut off the light momentarily at suitable intervals.

THE runner (Figure 2) carries a magnet around his waist or chest: the one shown is merely a hack-saw blade with its teeth ground off, and magnetised in a solenoid. As the runner comes up to a coil, the induction from the magnet through the coil increases, reaches a maximum when he is in its meridian, and falls off again as he passes on. The current induced in the coil is recorded on the galvanometer.

The record (Figure 1) is not a true picture of the current; to obtain that, an instrument of much shorter period (for example, the string-galvanometer) would have to be employed. If, however, the runner is reasonably close to the coil, so that his angular velocity is great, the deflection is very sharp and the point of the curve represents with considerable accuracy the moment at which he passes the meridian of the coil and runs toward the next coil.

THE AUTHOR

This informal picture was taken at Cornell University, where Dr. Hill has been conducting research on athletes

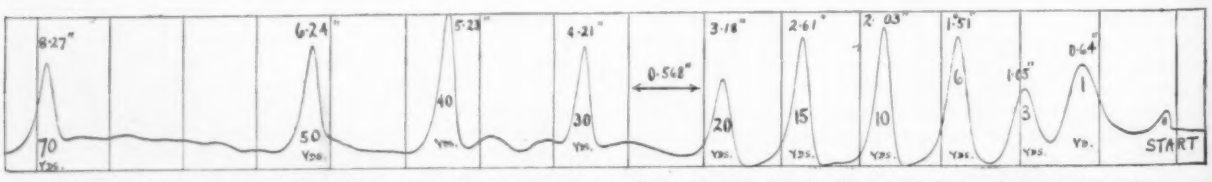
The magnet is no hindrance to the runner, and the system of placing the coils parallel to the track, instead of around it as suggested in my previous article, is much more convenient. For a permanent installation the best system would probably be to fix the coils with their planes horizontal, above the track, at a height, say, of seven feet, and to employ a vertical magnet on the runner. Six or more such coils could be placed side by side, and connected with the six strings of a "sound-ranging," string galvanometer, so that six runners could be recorded graphically in the same race on one strip of bromide paper. Such an installation, employed, for example, in the final heat of the 100-meters race at the Olympic Games, would provide results of quite exceptional interest.

To record the start, an electric switch is opened at the same moment as the signal "go" is given. This breaks the primary circuit in a transformer, and a current is induced in the secondary. To make the record smaller and more sudden this induced current is put through a second transformer, and the second induced current runs through the galvanometer. The upstroke of the starting signal is extremely sudden and can be read to 0.002 second if desired. If it were required to make the upstroke absolutely simultaneous with the order to start, the electric switch could be included in the pistol. Figure 3 shows the starting switch in use, together with the two transformers on the bench.

IN the record of Figure 1 the coils were placed at 1, 3, 6, 10, 15, 20, 30, 40, 50 and 70 yards, respectively, from the starting point, and the corresponding times are 0.64, 1.05, 1.51, 2.03, 2.61, 3.18, 4.21, 5.23, 6.24 and 8.27 seconds. The light was cut off momentarily every 0.284 second, leaving a little gap in the curve; lines have been ruled in through every alternate one of these gaps, from which the times are measured up. The runner in this case ran as fast as he could from the start.

In Figure 5 another record is given, in which the subject (a broad-jumper) ran as though he were going to carry out a broad jump, the coils being arranged at 1, 3, 6, 10, 15, 20, 25, 30, 35 and 40 yards, respectively. The object of this trial was to ascertain how far he needed to run in order to attain his maximum speed. In this particular run the maximum speed, 9.7 yards per second was reached in 30 yards.

The consistency with which records can be reproduced by a man in train-



RECORD OF A SEVENTY YARD DASH, AUTOMATICALLY MADE WITH THE ELECTROCARDIOGRAPH

FIGURE 1: *The start is at the right. The details which the record reveals are explained in the text of the article*

ing is remarkable. The subject of Figure 2 ran four times in the same afternoon, at intervals of a quarter of an hour, with results given in the following table:

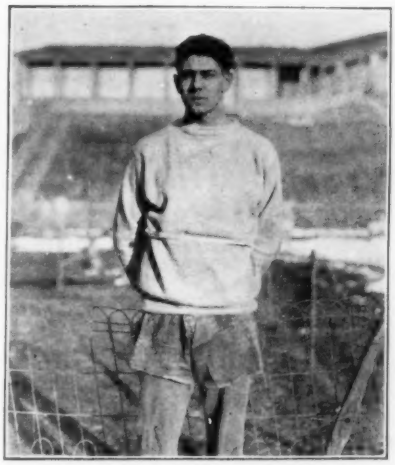
Distance Yards:	1	3	6	10	15	20	30	40	50	60
Time: Seconds (1)	0.67	1.09	1.58	2.12	2.74	3.30	4.38	5.43	6.51	7.56
(2)	0.63	1.07	1.56	2.10	2.72	3.28	4.36	5.42	6.51	7.58
(3)	0.62	1.04	1.54	2.08	2.71	3.27	4.36	5.43	6.53	7.60
(4)	0.67	1.07	1.56	2.10	2.70	3.27	4.35	5.41	6.48	7.50
Mean	0.65	1.07	1.56	2.10	2.72	3.28	4.36	5.42	6.51	7.56

The average difference between the mean and the observed time for any distance is only 0.014 second, which surely is a tribute to the consistency of the human machine.

THE amount of energy expended in fast running is very great, as was emphasized in my previous article. Quite an ordinary performer may finish a 100-yard sprint with an oxygen debt of six litres; in other words he will require six litres of oxygen to carry out the combustions necessary for recovery from his effort. One litre of oxygen used in burning glycogen (the chief—perhaps the only—fuel of muscular exercise) liberates energy to the extent of 15,800 foot-pounds, so that nearly 100,000 foot-pounds of energy may be used as the result of running 100 yards at top speed; probably in a first-rate athlete considerably more.

What is done with this energy? What resistances are the muscles overcoming? The air resistance, although not negligible, is fairly small, and cannot account for more than a fraction of the energy, since running at 10 miles per hour into a 10 miles per hour head-wind is nothing like so energetic as running at 20 miles per hour in still air. There is only one possible answer to the question: the resistance is mainly in the body itself, chiefly in the muscles.

In the last few years considerable research has been devoted to the "viscous" properties of muscle. If a muscle shortens slowly it does much more external work than if it shortens quickly, under otherwise similar conditions. There is a resistance, increasing with the speed, inherent in the muscle-substance itself. This acts as an automatic brake, preventing an animal from moving too quickly and so developing such high speeds in his limbs that they would be apt to break under their own inertial stresses. This resistance, in man, appears to be proportional to the speed at which the muscles shorten, and so is governed by the same rule as would hold for the case of simple viscosity, in a system deformed under a force externally applied. In such a system the energy wasted would be proportional to the speed of deformation.



RUNNER WITH MAGNET

FIGURE 2: *The magnet is simply a strip of steel tied across the runner's waist*

In muscles the effect is not really simple viscosity; it is due rather to molecular hysteresis in a physico-chemical system carefully adjusted by nature to the greatest speed at which it is expedient for the animal to move, in view of the limited strengths of his various structures. The effect, however, is similar to true viscosity, and obeys the same equations, so that we may work out simple formulae for the case of a man running, which fit the facts very closely.

If we assume that an athlete (mass M) begins to propel himself forward with a constant force (F) from the moment he starts, against a resistance which is $\propto$ times his speed, then it can easily be shown that the distance y covered in time (t) should obey the equation:

$$y = \frac{F}{\propto}\left[t - \frac{M}{\propto}\left(1 - e^{-\frac{\propto}{M}t}\right)\right]$$

It is possible to fit this equation to the observations with a high degree of accuracy. Taking $F/\propto$ as 9.43 and $M/\propto$ as 1.090, and allowing an absolute latent period in starting of 0.12 second, the distances calculated for the observed mean times in the above table compare with the observed distances as follows:

Observed	1	3	6	10	15	20	30	40	50	60
Calculated	0.97	2.99	6.05	10.07	15.20	20.10	29.9	39.8	50.0	59.9

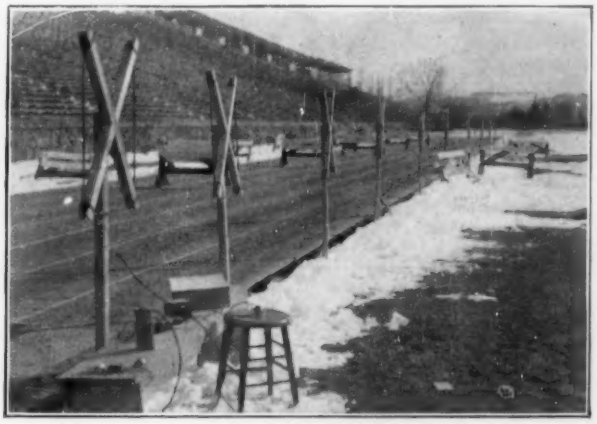
THE average difference between observed and calculated distance is 0.086 yard, that is, about three inches. No better agreement could be expected. It is obvious that in a short race we may regard an athlete as being propelled by a constant force, and resisted by a force proportional to his speed. Thus, like a raindrop falling through the air, he rapidly attains a certain limiting speed depending on the ratio of propelling force to resistance; and this speed will remain constant until other factors, for example, fatigue, cause it to fall off.

The value of F/M can be calculated from $F/\propto$ and $M/\propto$ by division. On dividing further by g (10.73 in yard-second units) we obtain the value of the force exerted, in terms of the weight of the man. In the above case the propelling force is 0.806 of the runner's body-weight. The highest value hitherto observed is 0.92, the lowest, 0.51.

Taking 0.85 as a typical value, this implies that an athlete, running 100

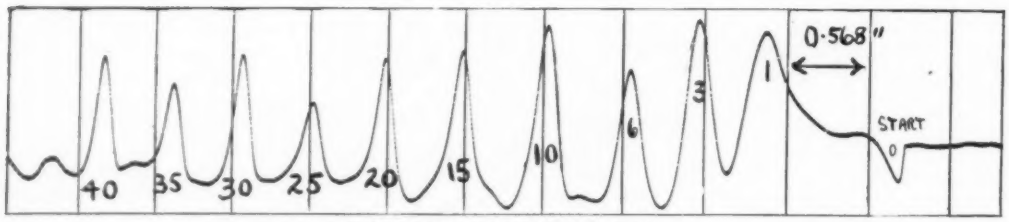
RECORDING THE START

FIGURE 3: *An electric switch held in the hands of Jack Moakley, famous coach, is closed when the word "go" is given*



THE WIRE COILS

FIGURE 4: *As the runner, with magnet, passes each coil, a current is induced in it. This is automatically recorded*



RECORD OF BROAD JUMPER

FIGURE 5: *How far must a broad jumper run in order to attain his maximum speed? Thirty yards, says the record. See text of the article*

yards at top speed does enough mechanical work to lift his body 85 yards into the air—about one third the height of the Woolworth Building in New York City. No wonder that he requires six litres or more of oxygen to recover!

Assuming his weight to be 150 pounds, the mechanical work done is about 38,000 foot-pounds, while the oxygen debt of six litres corresponds to 95,000 foot-pounds of total energy. Thus, reckoned in this way, his mechanical efficiency works out at 40 percent, a very high value, which to those acquainted with recent muscle-physiology will indicate that practically the *whole of the initial energy in muscular contraction may be transformed into mechanical work*, the remaining 60 percent appearing as heat in recovery.

We see therefore that the behaviour of an athlete, up to the stage when his velocity begins to fall off under fatigue (a matter still to be investigated) can be described with the aid of three constants and an equation. These constants are:

(1) The absolute value of his latent period, during which the starting signal is going in to his brain and is being signalled back to his muscles. This quantity is usually of the order of 1/10 second and is relatively unimportant. (2) His propelling force, which is usually about 0.85 of his body weight, but may vary fairly widely on either side. (3) His coefficient of "viscosity," defined by the quantity φ/M, which is usually about unity, but again may vary fairly widely. Given these constants, the behaviour of the runner is defined, and the differences between different runners can be described in terms of their constants.

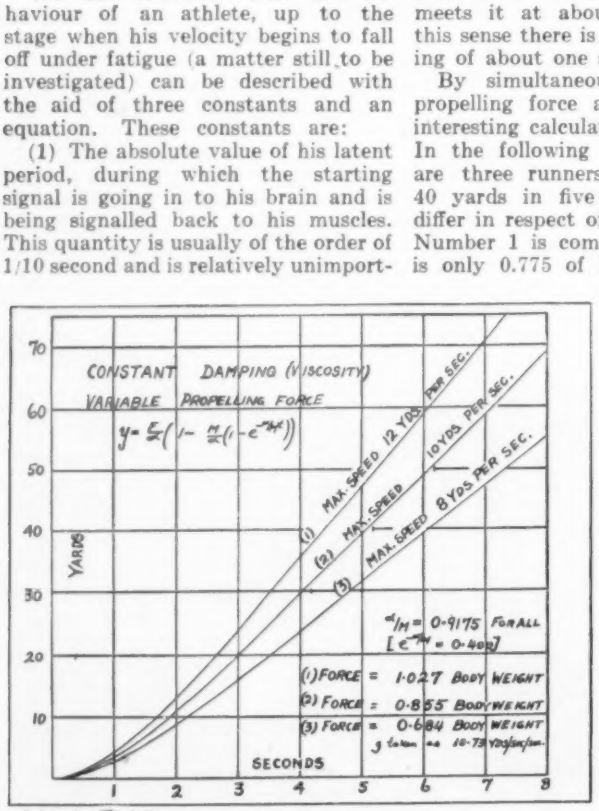
For example, in Figure 6 the distance-time curves of three runners, with constant "viscosity" but variable propelling force, are given. In Figure 7 the converse case is taken of constant propelling force and variable "viscosity." The curves explain themselves. In every case we notice that the maximum speed is practically attained in 20 or 30 yards, and that if the straight part of the curve be produced back to cut the horizontal axis, it meets it at about one second. In this sense there is a total lag in starting of about one second.

By simultaneously varying both propelling force and viscosity, some interesting calculations can be made. In the following table, for example, are three runners who can all run 40 yards in five seconds, but who differ in respect of their "constants." Number 1 is comparatively weak, F is only 0.775 of his weight, but he is very skilled in his movements and his "viscosity" is low, so that φ/M is small, namely 0.7775. His maximum speed is high, 10.70 yards per second, but he takes some time to attain it. Number 3 on the other hand is very powerful, F is 0.985 of his weight, but he is clumsy and "viscous," $\varphi/M = 1.079$, and his maximum speed is only 9.81 yards per second, although he attains it rapidly. Number 2 is intermediate: his constants are 0.873 and 0.9175, respectively, and his maximum speed is 10.21 yards per second. Their distances for various times are as follows:—

Time: Seconds	0.5	1.0	1.5	2.0	3.0	5.0	7.0	10.0
Distance: Yards (1)	0.92	3.26	6.57	10.53	19.65	40.2	61.2	93.3
(2)	1.02	3.53	7.00	11.08	20.20	40.0	60.4	91.0
(3)	1.11	3.81	7.42	11.58	20.70	40.0	59.6	89.0

We see that for the shorter distances Number 3 is the best man, for longer distances Number 1; and it is worthy of note that Number 1 is exerting only 89 percent as much energy as Number 2 in running the same distance, and only 79 percent as much as Number 3, so he will tire correspondingly slower.

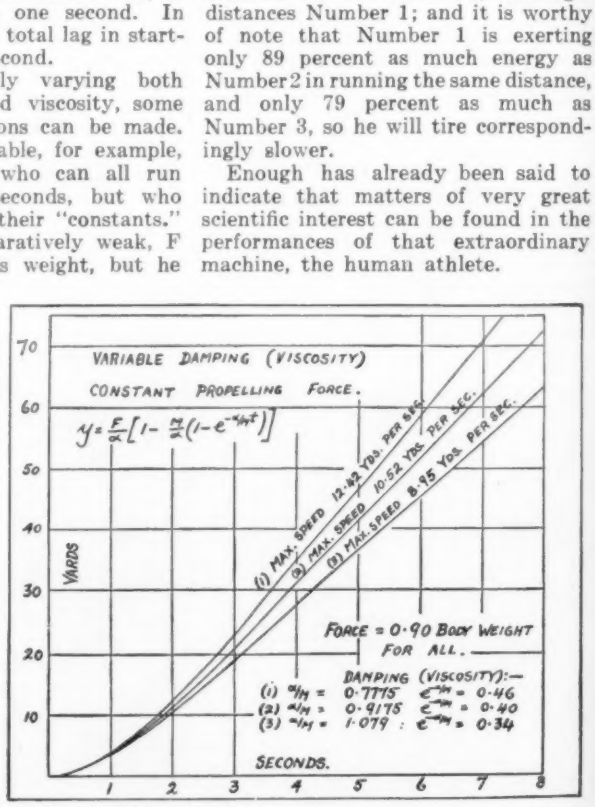
Enough has already been said to indicate that matters of very great scientific interest can be found in the performances of that extraordinary machine, the human athlete.


CONSTANT DAMPING (VISCOSITY)
VARIABLE PROPELLING FORCE
(1) MAX. SPEED 12 YDS. PER SEC.
(2) MAX. SPEED 10 YDS. PER SEC.
(3) MAX. SPEED 8 YDS. PER SEC.
φ/M = 0·9175 FOR ALL
(1) FORCE = 1·027 BODY WEIGHT
(2) FORCE = 0·855 BODY WEIGHT
(3) FORCE = 0·684 BODY WEIGHT
YARDS
SECONDS

Redrawn from author's diagram

DISTANCE-TIME CURVE OF THREE RUNNERS

FIGURE 6: *With constant viscosity but variable propelling force*


VARIABLE DAMPING (VISCOSITY)
CONSTANT PROPELLING FORCE.
(1) MAX. SPEED 12·42 YDS. PER SEC.
(2) MAX. SPEED 10·52 YDS. PER SEC.
(3) MAX. SPEED 8·95 YDS. PER SEC.
FORCE = 0·90 BODY WEIGHT FOR ALL.
DAMPING (VISCOSITY):—
(1) φ/M = 0·7775 e^-φ/M = 0·46
(2) φ/M = 0·9175 e^-φ/M = 0·40
(3) φ/M = 1·079 e^-φ/M = 0·34
YARDS
SECONDS.

Redrawn from author's diagram

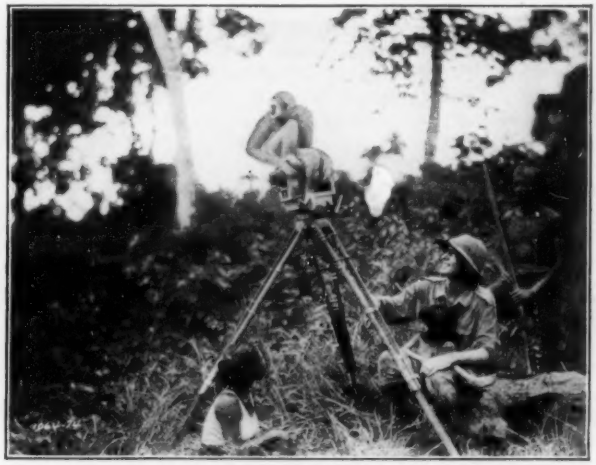
ANOTHER DISTANCE-TIME CURVE

FIGURE 7: *Conditions are the converse of those in the curve at left*

All photographs courtesy Paramount Pictures

THE PHOTOGRAPHERS AT PLAY

Mr. Schoedsack and Major Cooper with one of the tigers which they photographed and then killed



THE STAR COMEDIAN

"Bimbo," the gibbon comedian, is on the camera. Mr. Schoedsack and some native actors are watching him

Motion Pictures Record Jungle Life

Intrepid Cameramen Brave Many Dangers to Produce a Film Epic of Siam

By A. P. PECK

EQUIPPED with two motion picture cameras and two tripods, two men set out from New York to make a film in the jungles of Siam. Many months later they returned with thousands of feet of exposed film, which film, when cut and edited, was destined to make a unique place for itself in the film annals of the country. The picture was titled "Chang" and as such is now enjoying a long and popular run.

When the writer first saw a pre-release showing of the picture, he was of the opinion that much "trick" photography must have been resorted to in order to obtain the marvelous effects depicted. With this in mind he interviewed Ernest Schoedsack, who, with Major Merian Cooper, penetrated the fastness of the jungle to record on photographic film a simple yet fascinating story of the struggle of the natives of Siam against wild beasts and the wilderness. The results of the interview were as surprising as they were interesting. According to Mr. Schoedsack, he and Major Cooper took with them nothing in the line of apparatus that would enable them to take "trick shots."

"THERE were no trick arrangements used," said Mr. Schoedsack. "The only requirements for results, aside from the usual knowledge of photography, seemed to be hard work and then more hard work. Photography in the tropical jungle proved to be vastly different from that in the studio. We met with conditions that were not to be found in any other locality and the overcoming of these involved the hard work that I just mentioned. Consider working in a country where the days are hot, the sunlight brilliant, the majority of the colors photographically dull, the mornings and late afternoons invariably misty, and you will have an accurate picture of the photographic difficulties that we had to overcome."

The story of "Chang" briefly told is as follows: The members of a native family, more venturesome than the rest, have left the comparative safety of the village and started to build a home for themselves in the jungle, far removed from their companions. Here they encounter many difficulties. Wild animals kill and devour their stock and the man of the family builds traps in an endeavor to rid the territory of the predatory beasts. During one of the hunts a baby elephant is captured and is tied to one of the posts supporting the house. Soon the mother elephant appears on the scene and in her rage at the treatment of her baby, she proceeds to demolish the home.

AT THE WATER HOLE

This close-up of a wild tiger was filmed from a camouflaged shelter

THE native finds that the "great herd," a band of wild elephants that has not been seen for generations, is returning. He warns the villagers. Soon the herd appears and crashing through the village, razes it completely. The natives band together, build a sturdy *kraal* in the jungle and start a drive on the elephants. Using their native cunning to prevent a stampede, they gradually drive the animals closer and closer to the trap. Soon the elephants are captured and the process of training them for useful purposes begins. The venturesome native and his family then return once more to the wilderness, rebuild their home and begin again the grim battle with nature.

From this description it can be seen that there are innumerable possibilities present for the photography of wild animals in their native haunts, and Schoedsack and Cooper made the most

of them. Scorning the use of tame, trained animals whose actions were likely to be less natural than those of the wild beasts, they set to work to develop methods of photography that would produce the desired results and still have a certain element of safety in them. Some examples of the types of photographs taken will serve to show the ingenuity displayed.

DURING one of the hunting sequences, two natives were pursued by a tiger, which chased them up a tree. Sensing a chance for an unusual "shot" in this connection, Schoedsack built a light platform in a tree 13 feet above the ground. Taking his camera to this perch and mounting it so that the lens pointed straight down the trunk of the tree, he stretched out on the platform beside the camera ready to crank. In a nearby tree was Cooper armed with a rifle for use in an emergency.

The native beaters then chased a tiger to the vicinity of the tree in which the camera and cameraman were ensconced. Schoedsack started to crank and drew the attention of the animal. The latter looked up, caught sight of the human being in the tree, and started to circle round. Everything was going fine and the camera was recording an excellent picture of an angry tiger. Suddenly the beast took it into his head to try to get the man in the tree. Accordingly, with a single bound he fastened his claws in the trunk and frantically attempted to reach the platform. Calmly the cameraman continued to crank. Cooper was ready to shoot, but Schoedsack called to him to hold his fire as the tiger was ready to drop back, and surely enough, he did just that. After the excitement was over and the tiger had been killed, measurements showed that the beast's claws had left marks on the tree trunk 11 feet from the ground—only two feet from the platform.

For the filming of the elephant herd, a pit was dug. This measured about five feet square and seven feet in depth. It was roofed over with heavy logs, and a low turret of the same material was built in the center. This projected several inches above the level of the roof of the pit and served to protect the camera, to allow the lens to project a few inches above the ground level, and to provide a space for the cameraman to view the action. The logs forming the upper part of the turret were cut away so as to give more room for the camera and still not project too far above the ground. This construction, of course, weakened the top, and Mr. Schoedsack told the writer that he spent many anxious moments in the pit.

After the pit had been completed and the cameraman and camera were in place, the natives started to drive a herd of wild elephants through the jungle. They had to exercise considerable skill in doing this, as the herd had to be driven directly over the covered pit. Finally the cameraman saw the animals coming and started to "grind." At a terrific gait they approached the shelter and thundered over it. Bits of dirt and bark from the logs sifted through and added to the discomfort of the cameraman. After passing over the pit, several of the elephants turned and started back. The turret had been weakened by the passage of the herd, and when one of the returning elephants struck a certain spot in the back of the projection, it gave way. Luckily, however, the animal's foot was not caught and he proceeded on his way, after showering Schoedsack with splintered fragments of the broken logs.

THE ELEPHANT STAMPEDE

Crushing everything in their path, the elephants were photographed as they devastated a native village

In the course of the work recourse was had to other pits and camouflaged shelters. These were erected on or near animal trails through the thick jungles, and often the cameraman had to wait for hours in them until a chance came for a good shot. The shelters placed near water-holes were especially productive of good results. Some excellent photographs of wild animals at close range were obtained in these locations.

IT is interesting to note that no telephoto lenses were used in the filming of this picture. All of the photography was done at close range. One of the reasons for this was the fact that the use of telephoto lenses, while it has advantages, has many disadvantages. For example, with a long-range lens, the field of vision is restricted. Also, definition is not always

AT PEACE WITH THE WORLD

A native village on the edge of the jungle in Siam, typifying the quiet, simple life of the inhabitants

AFTER THE STAMPEDE

The same village shown at the left, after it was laid to waste by a herd of wild elephants

SETTING A SNARE

This photograph is typical of the many instructive scenes in "Chang," showing the life of the Siamese

MAKING A DEADFALL

Primitive materials and methods are used. The "spikes" are sharpened sections of bamboo, lashed to logs

all that can be desired when a lens combination of this type is employed.

During the 14 months that the cameramen spent in the jungles, there were innumerable battles with the wild beasts. Many of them had to be killed either during the action that was being photographed or afterwards. At all times the men carried guns and knives for their own protection, and these were never idle for any great length of time.

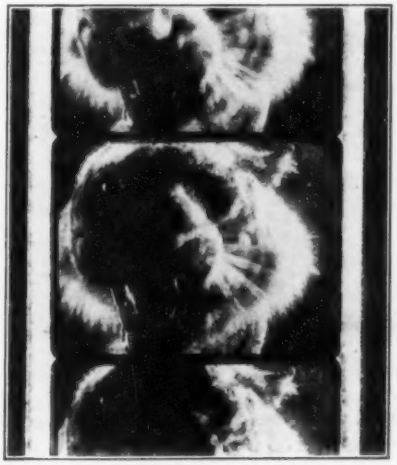
For a little comedy relief in the otherwise serious picture, the producers make use of a natural-born humorist, a white gibbon. The antics of this animal, caught by the ever-watchful camera, provided many moments of laughter which would be the envy of any human comedian.

In the performance of his role, "Bimbo," the gibbon comedian, exhibited many of his natural characteristics. For example, at one time he was running through the jungle with a rope that was tied around his neck trailing after him. To prevent the rope choking him in case it became caught, Bimbo held it tightly in one "hand."

A FEW small monkeys were also filmed. Mr. Schoedsack said that the sequence in which these little fellows were used was one of the most difficult parts of the whole picture to film. This was true because the camera had to be placed so close in order to get the desired results that the animals were frightened. Also, the monkeys, when placed in the sun where photography was possible, would insist on going to sleep.

The trials and tribulations of the cameramen were not confined wholly to the animals with which they had to deal. Photographic conditions were of a peculiar variety. When the sun was shining brightly, and in an ordinary climate the tendency of the photographer would be to "stop down" or use a small diaphragm opening, the photographers in Siam found that it was necessary to work "wide open." This over-exposured the film, but the ultimate result, obtained by using "soft" developer, was a negative of fine definition. This process had to be used because of the drab nature of many of the objects being photographed.

Because of the atmospheric conditions encountered in Siam, the film that was to be used had to be loaded in the camera magazines within a few



AT CLOSE RANGE

A section of the film where the tiger is depicted climbing the tree in which the camera is located. The tiger's head completely fills the "frames"

hours before it was to be exposed. Up to that time the film had to be kept in sealed, air-tight containers. Because of this requirement, a "changing bag" had to be employed for loading the magazines. This consists of a light-tight cloth bag provided with two holes for the arms. These holes are closed around the arms by means of elastic bands. To use this bag the material to be handled is placed within, the arms are inserted and the work carried on without the benefit of sight. Imagine groping in the dark in this way when the temperature is ranging around 110 degrees, Fahrenheit.

TO be sure that the film was amply protected from the humid atmosphere, that which the photographers took with them was packed in the following manner: The film was in 400-foot reels, ready wound for the type of magazines used. These were placed in standard 400-foot cans, sealed with adhesive tape, and this can in turn placed in a 1000-foot can. The edges of the latter were soldered. Then, when ready, the outer can was opened with a can opener, the smaller one placed in the changing bag and the work carried on. When on location, Schoedsack found that he would soon run out of film. Accordingly, he dispatched an order to one of the largest film manufacturers in the United States, giving definite orders as to the method of packing. When the film finally arrived it was packed in 400-foot cans only and these were soldered! Now, 400 feet of motion picture film fit snugly in a 400-foot can. To get at this film it was necessary to manipulate a can-opener inside the changing bag, spoiling many feet of film with the blade. The discomfort of the photographer can be imagined when the possibility of cuts from the jagged tin, together with the effect of perspiration on these cuts, is considered.

However, all difficulties were overcome and about two years after the venture was started, the producers had the satisfaction of seeing their film received with great acclaim.

¶ *Another "talking movie" has made its appearance and is now being produced commercially. Its technical details will be described at length in an article in our next issue.*

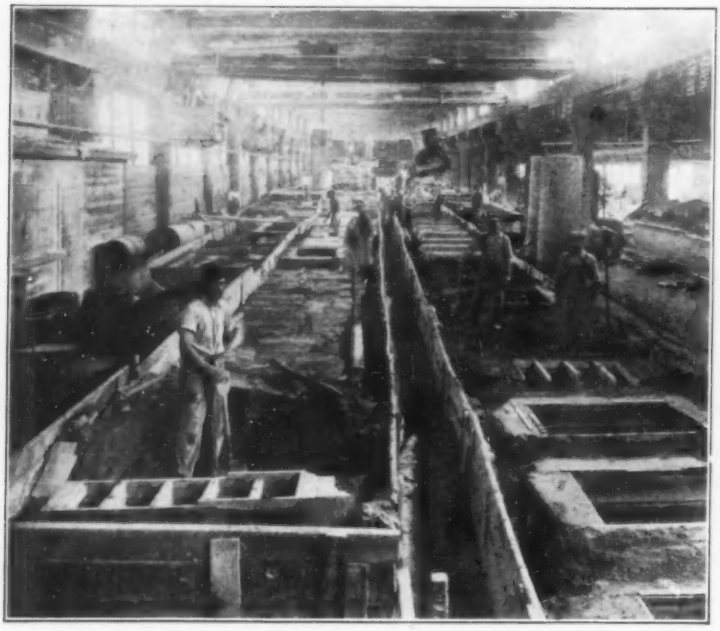
All photographs courtesy of Onondaga Litholite Company

THE MAIN PATTERN SHOP

Wood patterns for moulding stone require the same equipment and practically the same care in making, as for iron

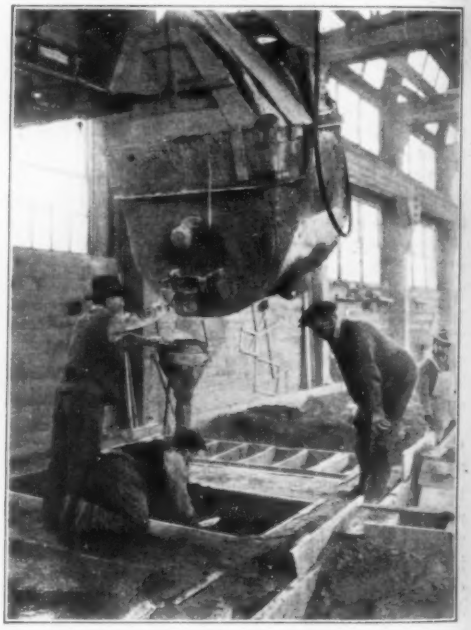
WHERE SPECIAL MODELS ARE BUILT

Metal patterns and special moulds are necessary where the finished details require more elaborate and finer treatment



THE CASTING FLOOR

Similar in almost every respect, one might readily think at first glance that this scene was taken in the casting department of an iron foundry

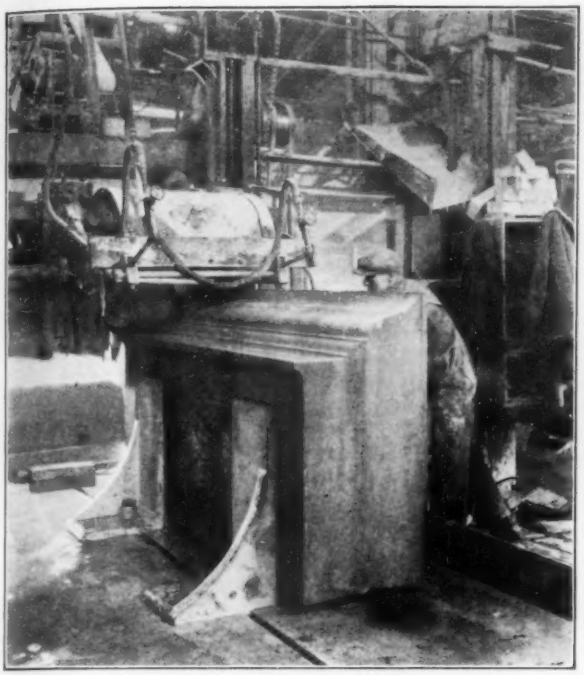


THE AGITATOR AND POURER

Each batch of the mixture is agitated until the last bit is poured into the moulds

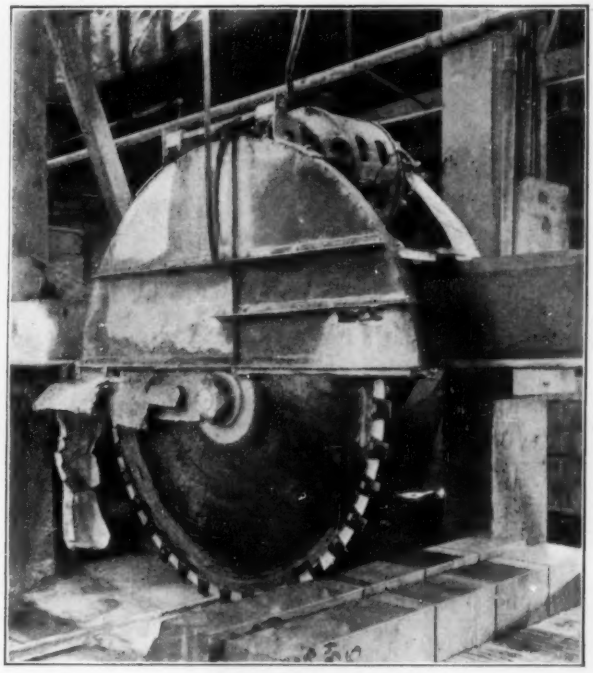
Stone Cast Like Iron

A study of the illustrations on these two pages reveals a striking similarity to the different steps in production in an iron foundry. Yet what you see is not iron—it is stone; stone cast and finished in almost the identical way that iron is handled. With this in mind it is interesting to follow through the process of producing cut, cast stone. Because of the necessity of having a flexible mixture, one part of cement is used to three and one half parts of marble or granite aggregate, with eight gallons of water to one bag of cement. Three sizes of aggregates are used —the largest screening through a one half inch mesh. After careful measurement, the batch is mixed for four minutes and is transferred to the agitator and pourer, where it is continuously mixed until the last is passed to the mould. This entire operation takes about ten minutes. The excess water which makes the batch thin enough to flow freely and fill the recesses of the mould, percolates off through the sand, leaving all the cement in the cast. Enough water is thus voided through filtration to give a resultant ratio of three and one half gallons of water to 94 pounds of cement. Twenty minutes after pouring, the cast has settled and become firm enough to trowel, and after 48 to 72 hours of curing in the sand, the stone is hard enough to shake out and pile, the moulding sand adhering to the cast to prevent too rapid curing. After two weeks of curing, the product is ready for me-



A MECHANICAL GRINDER

Here a cornice is being ground in a manner identical with operation in a machine shop. Carborundum wheels are used



CARBORUNDUM SAW

This is not lumber that is being cut, as you might be justified in thinking—it is stone that has been moulded to shape

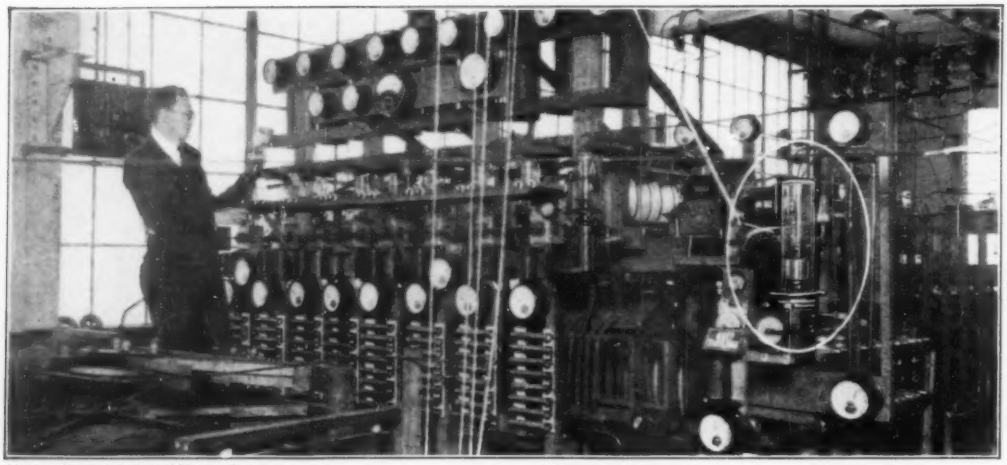
TRIMMING AND FINISHING

Hand finishing with pneumatic tools gives a surface which so closely resembles natural cut stone, both in appearance and durability, as to almost defy detection by observation

ARTISTRY OF A HIGH ORDER

The ornament appears to have been carved from a solid block

chanical finishing. Tests show that this method produces a concrete which runs high in compression strength and low in absorption of moisture. While cut, cast stone is not cheaply produced, because high-grade aggregates and considerable skilled labor must be used, there is a decided advantage in the facts that it is always uniform and that a wide selection of varieties in textures and colors is available. In fact, were it not for the saving made possible by moulding stone to approximately the shapes required, thereby reducing the labor of cutting and finishing to a minimum, it would be prohibitive in price. The use of ornaments and ornamental stone in modern buildings has increased of late years with the diversity of the styles of architecture developed, more especially because of the flexibility of design afforded by reinforced structures. So it is seldom that a building is now erected without the use of such artificial material. The many advantages of the use of cut, cast stone over similar ornamental objects carved by hand from solid blocks of rock are quite obvious when the entire situation is considered. In the cut, cast stone system, some of the advantages are as follows: Hooks for lifting and moving the heavier pieces are cast in the object. The larger casts can be made hollow so that the ultimate weight is reduced. Large columns can be made hollow, yet with steel reinforcement, they are as strong as solid columns would be. Conduits for electric wiring can be cast in the objects, eliminating the necessity of future boring. Where the stone object is to be suspended from structural steel, the necessary holding bolts are cast right in the stone. Furthermore, duplicates of ornaments can be made cheaply, using the original patterns.



Photographs courtesy General Electric Company

THE GIANT OF BROADCASTING

The 50-kilowatt transmitter at WGY and at the right in the oval, the 100-kilowatt tube which has replaced eight 20-kilowatt tubes in this high-powered circuit

Radio's Goliath

Latest High-powered Type of Vacuum Tube Stirs the Ether with Tremendous Force

By ORRIN E. DUNLAP, JR.

THREE outstanding engineering achievements destined to be recorded on the pages of history as 1927's contribution to the advance of radio are the transatlantic talk-bridge, the electrically operated receiver, and last but not least the 100-kilowatt transmitting tube introduced at station WGY, Schenectady, New York.

This enormous tube, the Goliath of broadcasting, mounted in its water jacket and ready for use, stands seven and one half feet high and can hurl more energy into the emptiness of space than the eight tubes, rated at 20 kilowatts each, which it replaced in WGY's transmitter. It weighs 100 pounds or one pound per kilowatt!

RESEARCH engineers who delve into the mysteries of the ether in an effort to improve wireless transmission and reception, are delighted with this powerful scientific ally which creates mighty waves in space and enables investigations with power up to 500 kilowatts or even more. The radio men in the laboratory of the General Electric Company, where the tube was developed, explain that the 100-kilowatt bulb is utilized as a radio-frequency amplifier, fulfilling in the transmitter a use comparable with the radio-frequency amplifier stages in most radio receivers. They point out that in the receiving system a feeble high-frequency oscillation intercepted by the antenna excites the radio-frequency amplifier tube, which intensifies the incoming impulses, giving them greater power to actuate the detector. In the transmitter, the output of one 20-kilowatt tube is amplified by the 100-kilowatt tube.

The tungsten filament in the big tube is eight feet long and about as large in diameter as the lead of a pencil. The filament contains two ounces of tungsten or approximately 750,000 times as much tungsten as the UV-199 type of tube used in some receiving sets. A spring, which resembles that used on an ordinary screen-door, supplies the several pounds tension necessary to keep the filament straight. Eleven horsepower or six and three-quarters kilowatts are required to heat the filament, which is equivalent to the electric power used to light 170 40-watt incandescent lamps.

The wires carrying the current to the filament must be as large as a lead pencil and the terminals attached to the wires are similar to those common in heavy switchboard construction. The tests disclosed that the high-frequency output of this tube, if utilized to supply power for 40-watt lamps, would light 2500 of them. The engineers call attention to the fact that in present-day dry-battery operated receivers, the power tube supplying the loudspeaker furnishes 11 watts of undistorted power for musical reproduction, while the 100-kilowatt giant supplies 400,000 times as much undistorted power.

An entirely new structural design had to be devised in the research laboratory in order to provide the necessary strength and durability. Outside of its water jacket, the tube is five feet high. Two thirds of its height consists of a copper envelope, four inches in diameter. The metallic envelope is called upon to serve a double purpose. It not only contains the elements of the tube but is, itself, the plate or anode of the device. The upper third of the tube is made of glass, through which the filament leads and the grid lead find insulated entrance. The glass bulb is 22 inches long and four inches in diameter and it is sealed to the spun-out end of the anode cylinder or copper envelope by a machine process. This is done in such a way as to make the junction of glass and copper mechanically strong and vacuum-tight.

TWO copper cables of a size capable of carrying a current of several hundred amperes act as the leads and are connected to tungsten rods, which in turn pass through a pinch seal. These rods serve as inner filament leads at the filament ends. Six lengths of tungsten wire, each about 16 inches long, connect to each of the inner leads, forming six parallel filament spans. These pass within the grid and, turned at angles, meet at a common point at the filament spring-suspension in the lower end of the tube.

The grid, within the copper envelope,

is cylindrical and has an over-all length of three feet, five inches. The grid frame is a most ingenious structure of molybdenum and tungsten. Bracing, of the type common in steel bridge and tower construction, is employed in the design of the frame to provide maximum strength with a minimum of metal. It is important that sufficient strength and rigidity be provided to prevent short circuits caused by swaying or sagging elements. A minimum

THE NEW TUBE

The young lady holds a detector for comparison with the giant tube

of metal in the grid structure facilitates exhaust of the air and minimizes the possibilities of gas evolution. The grid connection inside the bulb is brought out through an arm part way up the high-tension glass bushing to a flexible outside grid terminal.

Those who worked on the development of the tube explain that the degree of vacuum is as important, in its way, as the steam pressure is to a steam boiler. To guard against failure caused by high pressure increases which would be disastrous, a pressure gage, or more properly, an ionization gage, is attached to the big tube.

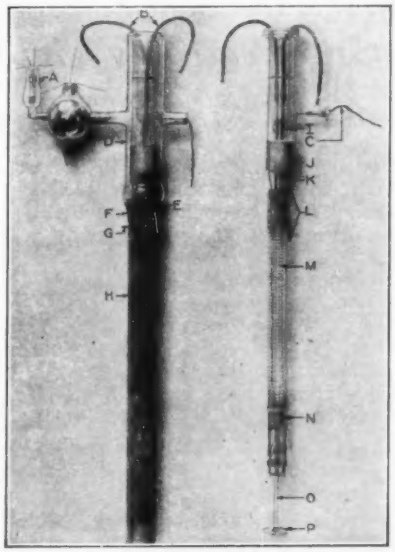
This gage is in the form of a special three-element vacuum tube, and in appearance is very much like an ordinary receiving detector or amplifier. It is sealed to the large tube and connections to filament, grid and plate are made from the pressure-indicating device to the operating panel. The gage operates on the principle of the ratio of ionization by collision with electrons, to the pressure or amount of gas present.

A new type of water-cooling jacket was introduced with the tube to provide uniform water flow around the anode in order to prevent unequal heating. It consists of an ordinary water-jacket with an inner flexible jacket which directs the cooling water past the anode.

The giant is now being operated as a plate-modulated power amplifier on WGY's transmitter where, due to the limitations of the circuit, the output is normally held at the comparatively low value of 50 kilowatts. Nevertheless, the engineers report that the limitations of the broadcasting system are not preventing them from securing valuable operating data on the Goliath of radio.

It was not many years ago that the arc, spark and high-frequency alternator dominated the field of transmission and it was not until the World War that the vacuum tube began to prove its utility as a means of producing electrical oscillations to set the ether in vibration. Since that time rapid advances have been made in the development of tubes for transmission purposes so that today, in commercial coastal stations, on board ship and among the thousands of amateurs, the spark is obsolete, with the more efficient vacuum tube in the regal position in transmitting circuits.

Not to be outdone by a broadcaster of entertainment, the Navy Department has installed an 80-kilowatt equipment, said to be the largest vacu-



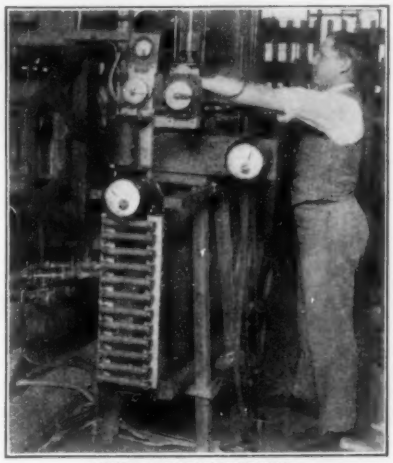
INSIDE THE TUBE

The letters designate the following parts: A, ionization gage; B, filament lead wires; C, grid lead; D, high-tension bushing; E, glass junction to copper anode; F, anode seal; G, securing flange; H, copper anode; I, filament pinch seal; J, grid supporting clamp; K, molybdenum inner filament leads; L, tungsten grid structure; M, parallel filaments; N, spring support for filaments; O, quartz support and insulator; P, spacer disk

um-tube transmitter in the world, at the naval radio station at San Diego, California, for communication with Washington and the Far East.

This installation, which sounds the death knell of the old arc transmitter long popular in the Navy, was not designed for telephone use but for radiotelegraph communication, using code which may be sent at the rate of 100 words a minute or about twice as fast as the average conversational speech. The apparatus is said to be four times as powerful as any other vacuum-tube transmitter employed by the Federal Government and it is capable of radiating about 80 times as much electric energy as the ordinary radiophone broadcasting station rated with a 1-kilowatt output.

So powerful is this San Diego installation, with its six-phase vacuum-tube rectifier furnishing direct current



THE TUBE'S BASE

Some of the water tubes as well as meters for checking operation

at 15,000 volts, 7.5 amperes for the plates of the oscillator and amplifier tubes, that it can communicate directly with station NSS, at Annapolis, Maryland, with the Hawaiian Islands, with Japan and with battleships and destroyers anywhere on the Pacific ocean.

The alternating current is first stepped up to a high voltage by means of a transformer, and then, passing through six kenetron tubes, is converted into direct current. A suitable filter, consisting of condensers and a reactor, is used to smooth out the "ripple" in the rectified current. For the transmitter proper, the master-oscillator power-amplifier circuit is utilized in conjunction with a "tank" circuit to insure the elimination of harmonics from the radiated output, so that interference will not be created for broadcast listeners. The master oscillator uses a single tube, which generates the radio-frequency power to be fed into the power amplifier. The latter consists of several pairs of "push-pull" units operating in parallel.

The first transmitters used at the naval stations were of the spark type, which radiated a damped wave. These were replaced by arcs and high-frequency alternators, which were a great improvement and gave greater effectiveness in communication, because they radiated continuous or undamped waves. Then came the vacuum tube as a means of setting the ether in vibration.

All photographs courtesy of the Museum of the American Indian, Heye Foundation

WITH DUGOUT CANOE AND POLES

Two Seminoles in the swamps of the Everglades of Florida. Modern reclamation methods spell the doom of the free, wild life of these American aborigines

The Conquest of the Everglades

Slowly, but Surely, the Seminoles of Florida Are Becoming Peaceably Civilized

By ARTHUR WOODWARD

Of the Staff of the Museum of the American Indian, Heye Foundation

SUB-DIVISION methods, and the loquacious tongues of chamber-of-commerce secretaries are at last accomplishing by peaceful means that which the United States Government failed to do 85 years ago by the use of guns and men; namely, the subjection of the proud and freedom-loving Seminoles who dwell within the depths of the swampy Everglades in Florida.

Seminoles, "Separatists" the name means, and separatists they have ever been in the true sense of the word since the first bands of those peculiar folk left the parent tribal body in Georgia, about 1750, and took up residence as a distinct tribal unit in Florida. Originally they were of what is known as Muskhogean stock, members of the Lower Creek towns, and their history has been one of turmoil and sorrow. First it was trouble and dissension with their own kind, and later, after their emigration, with the white man, particularly the Americans.

DURING the days of Spanish rule in Florida, prior to 1819, the Seminoles became involved in their first real war with the United States. The primal cause of this disturbance was the wrath of the Georgia slave holders against the Seminoles who had consistently welcomed to the swamps the run-away slaves of the whites.

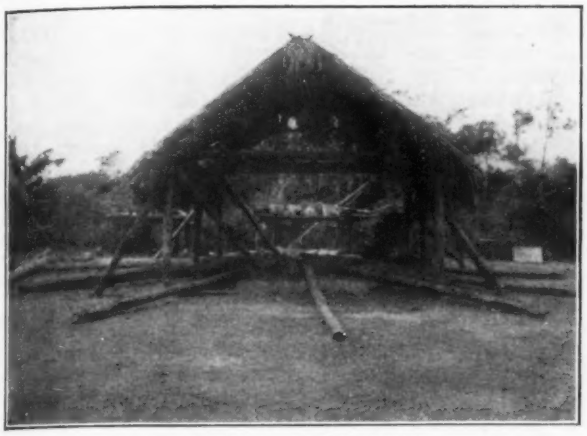
Even as early as 1776 the Georgia land holders were striving to prevent their human chattels from escaping to the Indian strongholds, but nothing was done until 1790 when a treaty was made by the United States Government with the Creeks, who agreed to aid in the capture and return of all escaped slaves, but nothing was done. In 1810, the Georgians decided to take matters into their own hands, the Government not having functioned, and there ensued a brief period of guerrilla warfare that ended in defeat for the whites.

SEMINOLE WARRIOR

Displaying barbaric taste in clothes, he carries a modern rifle

From then until 1816 the Seminoles and their allies were more or less at peace with the Americans. In that year a force of troops under General Andrew Jackson stormed a Spanish fortification on the Appalachicola River in which a number of Indians and negroes had taken refuge, and blew it up, killing some 270 of the 334 men and women who had fled behind its walls for protection. It was this frightful massacre that formally launched the "First Seminole War," and "Blount's Fort," the name of the destroyed works, became the magnetic rallying cry of the inflamed Seminoles, who straightway launched a campaign of retribution against the white plantation owners and government troops.

BY the treaty of 1819, when Spain ceded her rights to Florida to the United States for the sum of 5,000,000 dollars, the Seminoles found themselves under the dominion of the powers they most dreaded. The slave holders, now masters of the newly acquired territory, set up a vigorous clamor for the recovery of their run-away property. The United States, recognizing the Seminoles as a distinct tribe, undertook to negotiate with the Seminole headmen, agreeing to protect the Indians and their property, that is, slaves, herds, and farms as well as hunting territories, from the



A SEMINOLE COOK-HOUSE

The fire is in the center. The long projecting logs are pushed inward as they are consumed

ALL DRESSED UP FOR TRAVELING

A group of Seminoles on the way to a near-by town where they trade. Note the weird costumes

depredations of the whites if the Seminoles would accept certain tracts of land as their reservations.

After debating the proposition, the Indians accepted and retired from the outlying lands into the interior. For a time they were at peace but the slave holders, having won an inch, now proceeded to take a mile. They invaded the Seminole country with bloodhounds and chains, stealing right and left from the Indians. In vain did the Seminoles petition for redress of grievances. In 1828 the Government offered them new lands west of the Mississippi where they might be far away from their persecutors.

AFTER much persuasion, some of the tribal leaders agreed to make a trip of inspection of the proffered territory. They did so and returned, saying it was too cold a country as well as too dry and unhospitable. They decided as a whole not to emigrate. However, by pressure brought to bear upon a few, a treaty or agreement was signed whereby the whole tribe was supposed to be ready to move at a certain date. Naturally those who had no intention of going prepared to resist any efforts to move them. The appointed day arrived without a single Indian being ready to depart.

Troops were sent to enforce the removal order but it was no use. The Indians gathered their families, slaves and portable property and slipped deeper into the Everglades. For years they had been gathering supplies of powder and lead. Their natural resources of food were practically unlimited. Wild game was plentiful and for vegetable foods there were the acorns, palmetto "cabbage" and other native plants. It was war to the hilt.

At this period of the tragic drama, Osceola, or "The Black Drink Hallooer," a young Seminole leader of mixed Scotch and Indian blood, stepped onto the stage. While he was not formally a chief, he was accepted by the Indians as one of their foremost leaders and warriors, an Indian patriot if there ever was one.

The Second Seminole War began in 1835 and for a time, beginning with the frightful massacre of Major Dade's force of 110 men, of whom only two escaped alive, the Seminoles held the upper hand. General after general took charge of the American forces but were unable to accomplish anything tangible.

Osceola was the guiding spirit. The Seminoles looked upon him as their saviour. In the north, a public clamor

SEMINOLE AND WIFE

The "collar" worn by the woman consists of many strings of beads

arose for more energetic action on the part of the soldiers. General Jesup, then in command of the Florida forces, invited Osceola to a conference, under a flag of truce. An armed guard seized the young chieftain and his right-hand man, Wild Cat. This was in October, 1837. In January, 1838, Osceola died, a prisoner at Fort Moultrie, Florida. Wild Cat escaped to his people and, more embittered than ever, carried on the war until 1841, when he was captured by a ruse.

Failing to inveigle the wily chieftain to another treaty under the white flag, General Worth, having captured Wild Cat's little daughter, held her as ransom for her father's appearance. When the Seminole leader heard of the child's capture, then and only then did he consent to come within speaking distance of the American leader. It is related that when the old Seminole warrior came within sight of his baby girl the little one ran to him, holding out in her chubby hands, not flowers or fruit, but musket balls, which she had in some manner obtained from the soldiers.

After listening to General Worth, Wild Cat finally agreed to cease the warfare and emigrate with his people, In 1841 the war was technically over, and band after band of Seminoles, hearing that so eminent a warrior as the Wild Cat had given up, surrendered and made ready to move. By 1843 the last of the Seminoles who had agreed to emigrate had sailed out of Tampa Bay with their few scanty belongings—dusky Acadians bound for a new land of misery.

However, there were a number of Seminoles who steadfastly refused to leave the Everglades. They did, however, agree to maintain a friendly truce with their white neighbors and, keeping faith with their erstwhile enemies, they moved south into the uninhabited marshes of the lower peninsula.

THERE they have lived until this day, a shy, recessive people, holding aloof from all social contact with the whites. Few white men have become intimate friends with them. They have maintained their old customs, living by the products of their swampy plantations, groves of oranges and on the wildlife of forest and stream.

Ethnologically speaking, the Seminoles have always been an interesting people. Perhaps the main reasons for this interest are that they have

clung to their old ways, were not reservation Indians and have consistently refused to accept the Government invitation to go upon reservations set aside for them and be burdened with a lot of red tape "shall and shall nots."

FEW white men or women have ever gone among the Seminoles and won their whole-hearted trust or respect. There have been a few ethnologists and missionaries who have obtained some knowledge of them and their ways, but on the whole the Seminoles have adopted the attitude of "You let me alone and I will let you alone." They have feared to become educated lest they become like white men, because "white man heap lie too much." They point to the sad condition of other tribes who, having learned to read and write in white man's fashion, have signed away their lands and father's graves. Such things would never do for the Seminoles.

In times past, and even to-day, the Seminoles have lived by their guns and fish poles. They also tilled their small patches of fertile swamp land, raising such crops as sugar cane, sweet potatoes, corn, squashes, melons and fruit. They are skillful hunters and fishers, and while game is not as plentiful as it was at one time, due to the invasion of the white hunters, still they find enough to keep them fairly well supplied. Bear, deer, and alligators have been the largest victims to their modern rifles, while turtles and all manner of succulent fish teem in the waters. Living mostly on the water they have become experts with their canoes, and men, women and children pole the shallow wooden dugouts along the maze of tree-shrouded waterways of the swamps with amazing swiftness and skill.

Living as they do in a warm climate, their habitations and clothing are not elaborate. The houses are mere palmetto thatched, open sheds supported by sturdy logs which serve as catch-alls for miscellaneous collections of game pouches, guns, cast-off garments and cooking vessels. They keep their treasures of hand-made silver ornaments, ceremonial turbans and knick-knacks in chests or trunks.

Both men and women delight in long, flowing, beruffled garments of many-colored calicoes. The women do not follow the dictates of Parisian fashion by wearing short skirts. Their garments are both long and full, while around their necks they wear pounds of beads wrapped in close, heavy bands. The men usually wear a combination shirt and kilt costume, although some wear trousers. Around their home camps they are generally without either shoes or moccasins, but when they journey to the nearest white town for supplies they deck themselves out in shoes, trousers and gay shirts, and sometimes derby hats.

Many of their old customs still survive, but the last negro slave held by the Seminoles died recently. She was an aged negress who toiled for her red masters long after her brethren had been freed by Lincoln's armies.

Tribal law has always sufficed to keep the unruly in order. Murder and theft are rare among them but, when such things do occur, the criminals are punished in Seminole fashion. Not long ago a Seminole man murdered a boy. Instead of turning the slayer over to white justice, the Indians condemned him to death by shooting. The murderer asked time to settle his personal affairs. This was granted. He went away unattended and was gone 30 days. At the expiration of that period he returned, sat on the edge of the grave prepared for him and was tumbled over with a few well-placed rifle shots.

SOON, however, if one is to believe the newspapers, the picturesque dwellers of the Everglades will be mere nonentities. A young chief, Tony Tommy by name, has appealed to President Coolidge to end the 85-year-old truce. Chief Tony Tommy says he and his people are willing to come under the jurisdiction of the United States.

The clank of dredges draining the Everglades, and the thunder of dynamite blowing out obstructions, are outward signs that sub-division progress and civilization have stamped upon the Everglades.

There will be a few Seminoles, perhaps, who will continue to haunt the depths of the unreclaimed swamp lands —men and women of the old school who do not hold with the teachings of the popular Chief Tony Tommy who is striving to bring his people to a better understanding of their white neighbors. Just a few—but they will in time pass on, leaving a host of Indian place names and a multitude of legends to the new Florida. Then the conquest of the last primeval outpost of our American aborigines will be complete.

IN THE PINES

A primitive oxen-drawn cart on the way to the Everglades

A SEMINOLE FAMILY

Bead "collars" seem to be all the rage for the female members. Even the little girls wear them

PREPARING A MEAL

This side view of a female Seminole shows how the "collar" of beads extends part way down the back

Fish Elevator Aids Spawning

New Mechanism Carries Salmon Safely Over 250-Foot Hydro-Electric Dam to Spawning Grounds

By MANDUS E. BRIDSTON

WITH the advent of power developments, their hydro-electric dams extending hundreds of feet into the air from the surface of the river waters, the way to the salmon spawning beds seemed to be completely blocked. If the salmon could not get up the rivers to spawn, where would next year's pack come from? The problem not only involved the salmon industry with its investments of millions, but affected an important food supply. It seemed more than merely an engineering problem, so the engineers and icthyologists put their heads together and evolved a system of elevating fish to practically any height desired. Previous efforts showed that salmon would not of their own accord climb "ladders" over 50 feet high, so the system now used on the Baker River, in Washington, lifts thousands of fish annually over the 250-foot dam, with a loss of only 5 percent.

The fishway is probably the most elaborate and carefully designed that has ever been built. A concrete rack has been placed across the stream about 1000 feet from the foot of the dam, to prevent the salmon from nosing their way to that impenetrable wall of concrete.

The swift tail-water from the turbines is used to attract the fish to the entrance of the fishway, which is adjacent to the tail-water. When the fish grow weary of struggling in the tail-water, they seek refuge in a comparatively quiet pool provided beside the outlet from the turbines. In this pool the fish are trapped as they enter, and following his biological urge, the salmon ascends from this point through a series of smaller concrete pools, with walls between, over which the fish can easily jump. There are 25 such consecutive two-foot jumps, the fish climbing 50 feet in all.

The most important elements in this "ladder" of concrete pools, are the curved finger-like rods which are placed in each two-foot drop or rung of the ladder, and constitute a guard or trap. These rods do not make a barrier to movement upstream because the salmon invariably jumps over such water falls. But the salmon never leaps in his travel downstream —he merely allows the current to carry him back. This drifting backward is not possible with these traps, and hence the tired fish that would otherwise be carried back is kept in the pool, which is large enough to permit him to rest and recuperate for the still higher climb over the canyon wall.

When the salmon reach the last step of the ladder, they are carried 600 feet along a flume to the hoisting tank. Then begins the big ascent, 200 feet up a rail incline in a movable car. When a sufficient number of fish have entered this tank, the doors are closed to prevent the fish jumping out, pulled up a steep incline by motor, and emptied into a trough leading to the lake. The doors, or covers of this tank, serve as baffles to prevent the fish from over-jumping while it is open.

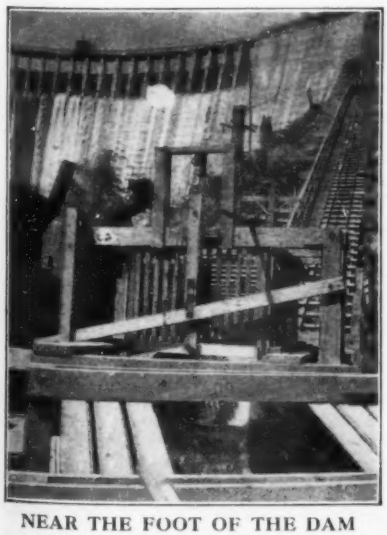
After being emptied into Shannon Lake, they begin swimming toward Baker Lake, which is connected to the former by a short stream. At the entrance to Baker Lake they are caught in a net and carried in large tanks to the government spawning grounds at the head of the lake.

Then begins again the exodus to salt water to renew the six-year cycle in the life history of the salmon. Millions of fingerlings fall over the 250-foot dam. This stupendous dive into the pool below is made with negligible loss of fish, for the engineers have made the dive easy. The two central gates of the dam are opened sufficiently to make this main overpour sought by the fish, while other gates on either side are opened slightly to provide a thin cushion of water on the concrete surface below.

The conflict between the salmon industry and the power interests has been definitely settled, and science has made the pilgrimage to the spawning beds less of a life and death struggle for the fish.

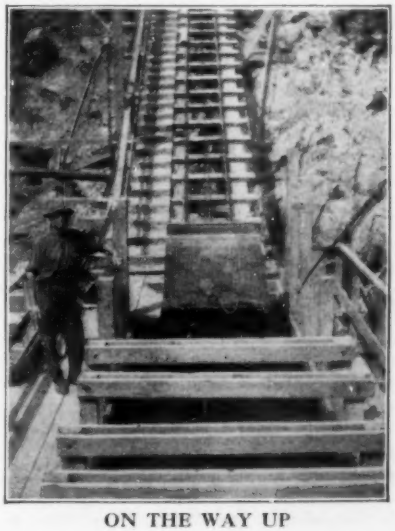
THE SALMON LADDER

The series of two-foot "steps" are shown here. Note the salmon photographed in the act of jumping



NEAR THE FOOT OF THE DAM

At this point, the salmon are caught in the steel compartment preparatory to hoisting to the top of the dam



ON THE WAY UP

The steel tank, with its load of fish and water, is starting up the inclined track toward the spawning waters above

The Month In Medical Science

A Review and Commentary on Progress in the Medical and Surgical Field

By MORRIS FISHBEIN, M. D.
Editor of the Journal of the American Medical Association *and of* Hygeia

Ultra-Violet Light

THE Council on Physical Therapy of the American Medical Association has made public the results of some investigations to determine whether or not the special forms of window glass which, it has been claimed, will transmit ultra-violet light, actually do so. The sun-parlor or solarium that is glazed with ordinary window glass permits the receipt only of the heat rays of the sun and does not allow the ultra-violet rays to pass. Since it has been shown that the ultra-violet rays are of great importance for proper growth of the human body and also in relationship to resistance against disease, several corporations have begun to manufacture and advertise glazing materials that will permit the passage of the important ultra-violet rays.

The Council on Physical Therapy examined two glasses, Vita-glass and Corning glass, which are real glasses. One substitute, Celo-O-Glass, is composed of wire-mesh screen filled with a sort of celluloid material. Flex-O-Glass is a thin, fairly loosely woven cloth treated with a paraffin-like substance. The materials were examined by placing them in front of the slit of the spectroscope and determining their absorption spectrums. The materials which were translucent and which scattered the rays were tested by a special apparatus devised for the purpose.

A biologic test was also performed on chickens, determining by their gain in weight and by their growth whether or not they were receiving adequate amounts of ultra-violet light through the various glasses.

Corning glass and Vita-glass were found to be as transparent to visible rays as is window glass. The Celo-O-Glass and Flex-O-Glass are not transparent, but were found to be useful in solariums and for the raising of animals or in other instances in which a transparent glass is not essential. Both of the latter substances are less expensive than ordinary window glass, but the Flex-O-Glass does not withstand the severe weather as well as does the Celo-O-Glass. The waxy coating has a tendency to soften in hot sunshine, and dust will adhere to the softened surface. All of the materials mentioned were found to have the property of passing the ultra-violet or health-giving rays of sunlight. The Vita-glass and Celo-O-Glass transmitted a sufficient amount of ultra-violet rays to control the development of rickets. The Flex-O-Glass did not transmit these rays so well, but even this substance was much better than ordinary window glass.

Loose Jointed or Double Jointed

ALMOST everyone is familiar with the contortionist of the vaudeville stage or the circus, as well as with persons in his own acquaintanceship who may have the mobility of the joints commonly referred to as "double jointedness." It is realized that the joints of thin people can be moved farther than can the corresponding joints of the fat. There are many thin persons, particularly women, whose joints in the knee, elbow and fingers can be bent in either direction to extraordinary degrees. Dr. J. Albert Key, of St. Louis, has described some instances of unusual mobility of the joints occurring in various members of a single family.

DOUBLE JOINTEDNESS
This condition is a sex-linked hereditary characteristic, as explained in the text

In the case concerned, the father had hypermobility, but the condition was not present in his parents or in any of his nine brothers or in his sister. It was, however, transmitted by the father to all four of his sons but not to any of his five daughters. Although the father's feet were normal, except for unusual mobility of the joints, all of the male children were born with deformities of the feet of the clubfoot type, whereas none of the girl children had such deformities. Apparently the condition is transmitted according to what is known as a sex-linked hereditary characteristic, transmitted as dominant in the male line. The joints are weak because of some developmental defect which makes the ligaments loose, although they may appear to be as strong as they should be normally.

Boric-Acid Poisoning

THE tragic deaths of six babies from drinking concentrated solutions of boric-acid solutions instead of distilled water because of error in the preparation of the solutions has called attention to the potentialities of boric acid as a poison. Compared with carbolic acid, lysol or bichloride of mercury, it is relatively nonpoisonous. There are, however, records of deaths even of grown persons who have received considerable quantities of solutions of boric acid. In some of the cases that are reported in medical literature, one to three grams or one fourth of an ounce of boric acid has produced serious symptoms, and from one half ounce to an ounce of the drug has been fatal to an adult.

In the cases reported the babies weighed about seven pounds and must have received at least a pint of saturated solutions of boric acid in 24 hours, or approximately one fourth of an ounce of boric acid. This substance is used so frequently as a household article that its power for harm has been overlooked. However, it has been forbidden to use boric acid as a food preservative in the United States, France, Germany, Holland, Italy and Spain.

The Health of the Eskimos

THE MacMillan Arctic expedition of 1926, visiting the Eskimos of northern Labrador and of Greenland, was accompanied by a physician who used his time in making studies of the Eskimos' diets to determine some im-

portant facts. These Eskimos live for the most part on diets consisting largely of meat and fish. The meats concerned are those of the whale, walrus, seal, caribou, musk ox, artic hare, polar bear, and fox, as well as those of geese, duck and gulls. The fish are varied. This food is usually eaten raw.

The physician, Dr. William A. Thomas, reports that, contrary to general opinion, the Eskimos eat relatively little fat or blubber, using these portions for oil in lighting their homes, in melting ice and snow for drinking, and, to a very little extent, for cooking food.

The Eskimos prefer red meat, eating the flesh and particularly the liver of animal or fish. However, when the supply of food is inadequate, they will eat any part of the animal, including the entrails. Dr. Thomas reports the unusual fact that the polar bear's liver is for some reason poisonous and that even starving dogs will leave it untouched.

Since meat is commonly forbidden to persons with kidney disease, he made a special examination to find out whether or not these Eskimos suffered unusually with these disturbances. He found, however, no unusual prevalence of blood-vessel or kidney diseases, or even of high blood pressure. These Eskimos lead a life of some physical activity, involving violence, accidents, starvation and freezing. Due to varying food supplies they frequently alternate between overeating and starvation.

Dr. Thomas did not find any scurvy or rickets among these Eskimos—conditions that are known to be due to absence of certain vitamins from the diet. The children are nursed for four, and not infrequently for six years, until their teeth are strong enough to permit them to eat meat. It is well known that the tissues of the animals and the fish, including particularly the liver, are rich in important vitamins.

In Labrador, the meat is cooked instead of being eaten raw. The natives eat much dried and canned food, and there is much scurvy and rickets, even though the Labrador mothers also nurse their babies for long periods. Since the mothers themselves eat only sophisticated diets, they do not have in their milk the necessary vitamins for their nursing offsprings.

It is interesting to know where the animals themselves secure their vitamins in their diets. The birds eat fish; the polar bear eats seal; seal eats fish; walrus eats clams; the caribou, hare and musk-ox eat moss, grasses and such sparse vegetation as may be found; the smaller fish subsist largely on marine vegetation, and thus, Dr. Thomas points out, the vital question apparently is answered by the well-known scriptural saying that "All flesh is grass."

A Collapsed Lung

SOMETIMES during a serious surgical operation, or after a serious attack of disease, the lung on one side, or on both, will suddenly collapse so that it will no longer act as a bellows capable of filling with air and emptying itself. The symptom is a serious one, since complete collapse of the lung does not permit the entrance of air and the patient dies promptly. If only one side is collapsed, as is usually the case, the person may develop severe symptoms, which, however, tend gradually to disappear, so that after two or three weeks the lung suddenly is reinflated and the person makes a complete recovery. The X-ray pictures accompanying this item indicate the appearance of the chest when normal and after there has been a complete collapse of the lung on one side.

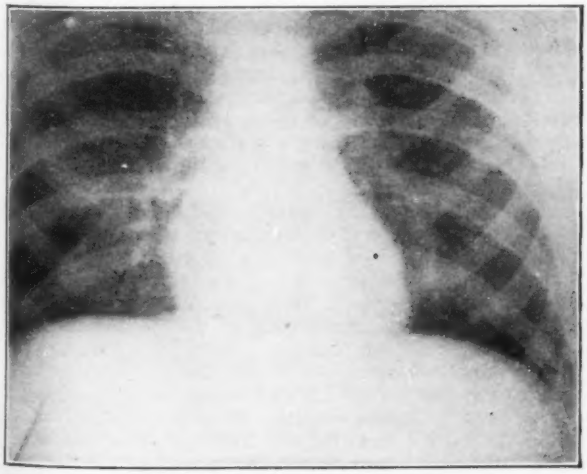
Dr. L. R. Sante, of St. Louis, recently discovered a simple procedure to be used during surgical operations when this symptom occurs. He found that merely rolling the patient over on the side that was not collapsed and causing him to cough would cause the collapsed lung to reinflate itself promptly with air and resume its functions.

With the usual thought of prevention rather than cure in mind, he suggests that, after all operations, patients be rolled first on one side and then on the other and that they have their positions changed every few hours during the first few days after the operation in order to avoid this possible complication. The exact cause of the condition is not known, but it apparently has something to do with a temporary injury to the nerves that control the actions of the breathing apparatus.

Changes in Children's Clothing

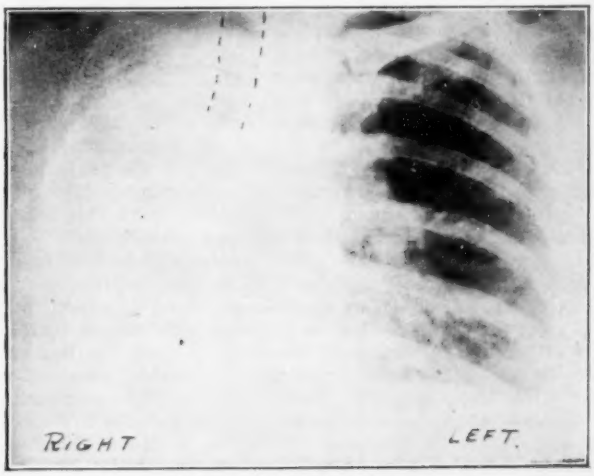
A WELL-KNOWN manufacturer of children's clothing in New York City has made available an experience of the concern of great interest from both an anthropologic and medical point of view. The firm has been in this business for 38 years. It is now recorded that complaints are being received that the neck measures of dresses for babies one, two and three years of age were not large enough, and it has been necessary to increase these measurements by one inch in each case.

Whether or not this observation is related to a change in body form in the American type or whether it has to do with an increasing tendency to disturbances of the thyroid gland is, of course, not determined, but the facts themselves are interesting.



X-RAY OF NORMAL CHEST

Both of the lungs are in their normal positions and are functioning as they should. Collapse has not as yet taken place



ONE LUNG COLLAPSED

Four hours after an operation, the right lung has completely collapsed. Rolling the patient from side to side prevents this

Successful Inventors—VIII

They Seek More Than Money, Says One of Them

By MILTON WRIGHT

"THE inventors who read the SCIENTIFIC AMERICAN are interested in the outstanding inventors of the country," we said to C. Francis Jenkins, whose first conspicuous invention was motion pictures—called the Phantoscope in those days—and whose latest invention—radio vision—promises to be just as epoch-making.

"These inventors are seeking knowledge and inspiration," we went on. "They are interested, not so much in being told what to invent or how to invent, but in finding out how they can reap the benefits of their inventions. In other words, how to make money out of their ideas."

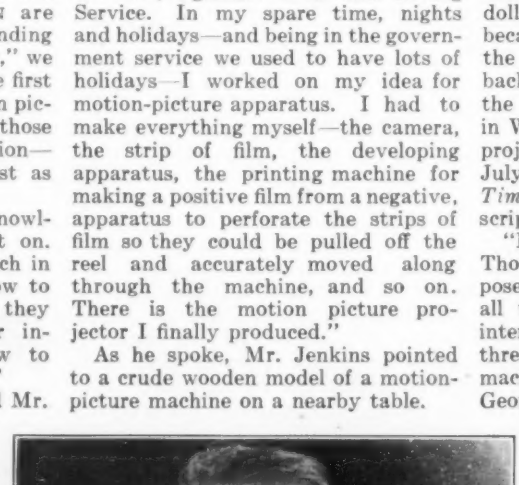
"I do not agree with you," said Mr. Jenkins. "I know of no *pioneer* inventor who is actuated primarily by a desire for money. Take my case, for example. I am a professional inventor. For years I have been earning my living by inventing. I am still inventing, but whether I make a lot of money out of my invention, or whether I don't, does not interest me greatly. I invent because inventing is what I like to do. I think the same thing is true of all inventors of *pioneer* inventions.

"HERE is another thing that I believe is true of all great inventions. There is no great invention that I know of which has been produced by men trained and experienced in the line which naturally would be expected to produce such an invention. The cotton gin was invented by a cabinet maker; the steam engine was developed by a miner; the telephone by a teacher of the deaf, and so on. I was a stenographer when I invented motion pictures."

"But how did you get started at being a professional inventor?"

"Frankly, I don't know what really started me, that is, what gave me the idea for my first invention. I was raised on a farm and I probably was born with a talent for machinery. As a boy on the farm out in Indiana I was supposed to keep all the farm machinery going. It was while on the farm that I learned stenography. I obtained a text book and used to sit on a plow-beam studying it. This knowledge eventually brought me to Washington. In 1890 I became secretary and stenographer to Sumner I. Kimball, organizer of the Life Saving Service. In my spare time, nights and holidays—and being in the government service we used to have lots of holidays—I worked on my idea for motion-picture apparatus. I had to make everything myself—the camera, the strip of film, the developing apparatus, the printing machine for making a positive film from a negative, apparatus to perforate the strips of film so they could be pulled off the reel and accurately moved along through the machine, and so on. There is the motion picture projector I finally produced."

As he spoke, Mr. Jenkins pointed to a crude wooden model of a motion-picture machine on a nearby table.



C. FRANCIS JENKINS

Mr. Jenkins was a pioneer in motion-picture work and is now engaged in the development of radio vision apparatus

"In all its essentials," said he, "that is the same as the motion-picture projectors in use in every theater today."

"How long did it take you to produce that?"

"It took a couple of years before I got projection. In January, 1892, I made the first successful projection with an oil lamp. In the next year I used a carbon arc. About January, 1894, I obtained my first patent."

"Did you sell your patent immediately?"

"No. There was nobody to sell it to. Like all inventions, this one needed capital for development purposes, and a friend, James P. Freeman, advanced me some money—about 50 dollars, I think it was. Freeman became ill after a little while, needed the money, and I began to pay him back in installments. Early in 1894 the device began to attract attention in Washington, for I gave exhibitions, projecting life-size pictures, and on July 6th of that year, the *Photographic Times* printed an interesting description of it.

"In 1895 I made an agreement with Thomas Armat for promotion purposes. Mr. Armat was to assume all the expenses and to get a half interest in the patent. We made three machines, copies of my 1893-4 machine, and took them to Atlanta, Georgia, where the Cotton States Exposition was being held. An account of test exhibitions given with these machines before they were shipped south was reported in the Baltimore *Sun*, of October 2, 1895.

"At the exhibition in Atlanta we got hold of the best 'ballyhoo' man we could, to try to get people to come in to see this wonderful new invention, for 25 cents. They would not come because the barker could not make them understand what it was. Do you know, you cannot describe motion pictures to people who have not seen them? People have to see motion pictures to know what they are like. Finally we solved the problem by inviting people to come in and sit down and rest. Then when we got enough of them in the hall we would put out the lights and start showing motion pictures. When we finished we would suggest that if they cared to they could leave 25 cents at the box office for the show they had seen. Many of them paid. We had a few real feature pictures. Some of them were as much as 100 feet long!

"IN January, 1896, Armat exhibited the machine at the Postal Telegraph Building in New York in an effort to interest some men with money. At this time Edison was getting interested in the subject. He had invented a peep-hole machine. I went to Philadelphia and demonstrated my Phantoscope at the Franklin Institute. By this time Armat and Edison had got together and Armat protested my claim that I was the inventor of the Phantoscope. Nevertheless, the Franklin Institute

committee reported favorably on my claim and also reported adversely on Armat's protest, and I was awarded the Elliott Cresson gold medal in 1898 for the invention of the Phantoscope. Thirteen years later the Franklin Institute awarded me the John Scott medal for improvements on the same invention."

"Did you make enough money out of moving pictures as you went along to keep you going?" we asked Mr. Jenkins.

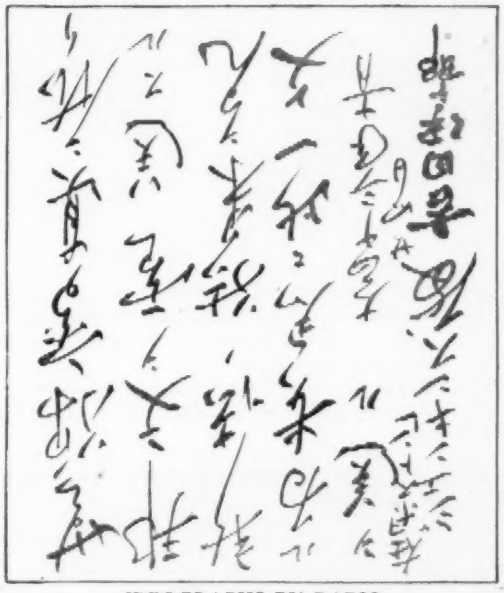
"No, indeed," he replied. "All this time I was working as a secretary and stenographer, but soon after the fight with Edison was over I went to Mr. Kimball and resigned. I determined to be a professional inventor. I was like the inebriate who bought a saloon so that it would either kill him or cure him.

"I HAVE never given up motion pictures entirely. Some 15 years ago I made a 'movie' machine, calling it the Graphoscope, a machine designed especially for use in schools. All of the film was placed below the source of light so that a booth would not be needed, and there would be no danger of fire. Many cities and several states endorsed it."

"But how did you put the machine on the market?" we asked. "Did you just sell your patent or lease it on a royalty basis?"

"I went to New York with the school machine," he said. "The promoters to whom I talked laughed at me. They ridiculed the motion-picture business generally, because motion pictures were considered rather disreputable in those days. My idea was to make the 'movies' respectable, to utilize them as a means of education.

"The men with money were not convinced, so I came back to Washington determined to prove that I was right. I organized a little company, manufactured machines and induced the principal of every high school in the city of Washington to install one. In a radius of 50 miles of Washington we sold ten times as many machines as all our competitors combined. After a year I went back to New York with the evidence. Within a week they gave me 60,000 dollars, and more later.



IDEOGRAPHS BY RADIO

This reproduction of a message in Japanese was sent and received by the Jenkins system of radio picture-transmission

"Most of my motion-picture work since that time has been along specialized lines. For example, I have invented a camera which takes photographs on a standard motion-picture film at the rate of 3200 exposures a second. This produces wonderful slow 'movies' which are extremely valuable in studying movements of many kinds."

"But what is your most profitable invention?"

"The spirally wound, waxed-paper container for liquids. It was designed originally to take the place of ordinary milk bottles. The milk bottle, it was estimated, costs five cents and makes ten trips. Then, too, milk bottles are more or less unsanitary. We made a good many thousands of these containers to take the place of milk bottles, but we found that we could not make much money competing with the glass bottles which only cost about a half cent a trip.

"We decided to find other uses for the container, and it was not long before it was being used for oysters, butter, pot cheese, ice cream and a wide range of products. We doubled the price of the containers."

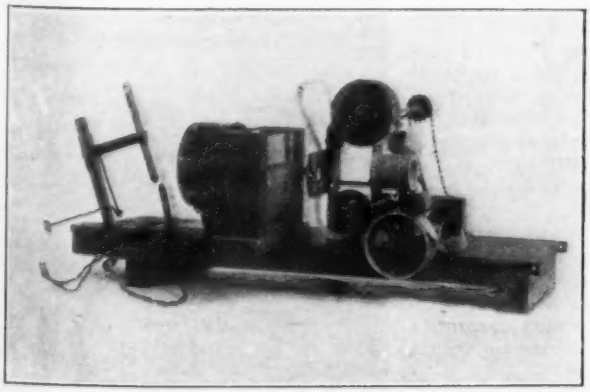
"Did you manufacture the containers yourself?"

"YES, we formed a corporation to put the new article on the market. There had to be a lot of machinery invented, for nobody had ever before made such a paraffined tube out of manila paper. The thing was pretty successful, and I sold out to a New York group after having obtained about 80 or 90 patents in that particular field. This was about five years after I had first invented the container."

"What do you consider your greatest invention?"

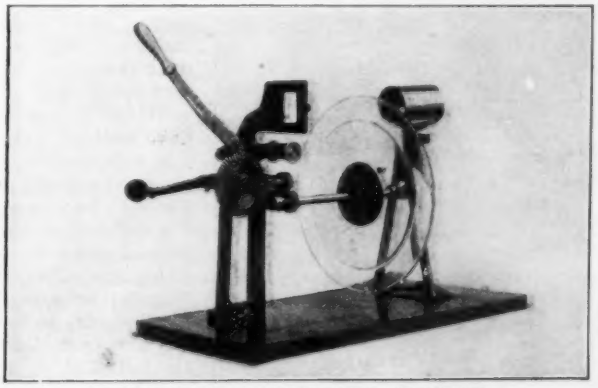
"Like many inventors I consider that the greatest is the one that I am now working on—visual radio. With this invention the wireless will carry motion pictures into the home. I already have about 35 patents on the invention and about 70 are pending. A number of things had to be devised. Motion pictures can be made only on flat surfaces. We had to develop mechanism to work on flats. We had to send a ray of light in an oscillating straight line, and so I invented a prismatic ring which is a solid glass prism which changes the angle between its faces. We would be having radio 'movies' in the homes now if I had not been interrupted by the Government last August to develop the radio weather-map.

"It is the radio weather-map upon



MOTION-PICTURE CAMERA OF 1895

The motion-picture projectors of today are very similar mechanically to this original model of Jenkins'

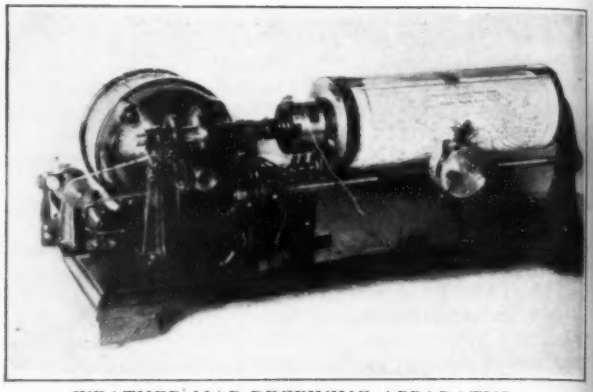


HIGH-SPEED CAMERA MECHANISM

Designed for the analysis of motion, this ingenious device is now on exhibition in the National Museum

RADIO PICTURES IN THE HOME

Mr. Jenkins predicts that it will be only a matter of months when this form of entertainment will be available



WEATHER MAP RECEIVING APPARATUS

The stylus records the received impulses on the paper attached to the cylinder, which is driven by the motor

which I have been working for several months. Professor Charles F. Marvin, head of the Weather Bureau, Map-Division Chief Calvert, Captain McLean, head of Communications in the Navy and Commander Hooper, head of radio in the Navy, asked me if it was feasible to transmit weather maps by radio to ships at sea. I said it was, and started work to devise a way of doing it. The Weather Bureau prepares the daily weather-maps, and we receive them at 11 o'clock every morning. They are then put on our machine in the Navy Building which is connected to the Arlington radio towers by wire. The maps are broadcast as radio impulses or signals in a special form.

"Aboard ship there is, attached to a radio set, a small machine on which we have affixed a map blank. As the impulses are received by radio from the broadcasting antennae at Arlington, they are written in contrasting colors on the map blank. The apparatus is now working with complete success. In the tornado which swept the Florida coast, the *U.S.S. Kittery*, which was receiving the maps, was effectively warned in advance and able to change its course and skirt around the edge of the storm. In a short time I hope to be able to get back to visual radio and devote my time and energy exclusively to its development."

"How soon do you think it will be before we will have motion pictures by radio?"

"I believe it is now only a matter of months before radio 'movies' will be available to the public."

"Will we be able to use the radio receiving sets we have now for receiving motion pictures?"

"I do not know yet. It all depends on whether or not we can use the present broadcast band. But this you can be sure of; we will be receiving motion pictures by radio in the home at no distant date."

"Do not great inventions nowadays come usually from the laboratories of great corporations by research engineers?"

"NO great pioneer invention has been made in the laboratory of a great corporation; and by pioneer inventions I mean new mechanisms which started new industries. It is always some outsider who makes the great innovation.

"The corporation laboratories exist to make improvements, perfect inventions upon which the industry is founded, simplify methods of manufacture or devise new items of manufacture. Their purpose is not to produce inventions upon which to found new industries.

"Here is another peculiar thing I have noticed. Great inventions in a new field are not usually taken up by those who would seem to be the most likely to be interested. For example, Dr. Bell told me that the telephone was turned down by the Western Union Telegraph Company. It seems as though it takes men outside of a particular industry to have vision enough to see the possibilities which lie within the industry."

"Wouldn't you say, Mr. Jenkins, that inventors are born and not made?"

"Yes, in a sense, but a lot of work and training can do much to develop a man's native ability. Probably a lot of playing around with tools and machinery is necessary before a man is able to work out his ideas to a point where they will amount to invention. I cannot remember the time when I was not interested in making wheels go 'round; then I went to Mexico and had a lot to do with mining machinery. Altogether I had a pretty good background before I started seriously the job of inventing."

"You have said that inventors are not interested primarily in profits. What would you say interests them more? What compensates them more than money?"

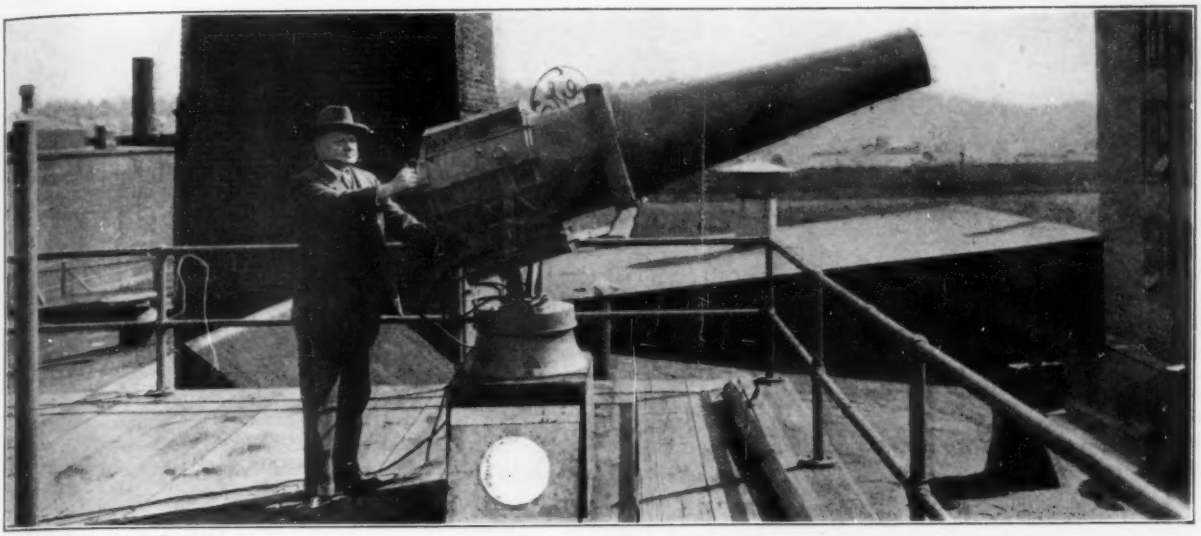
"Your real inventor is like your real poet or composer or sculptor. He takes an idea and he molds it and shapes it into tangible form. Out of nothing he makes something that is useful, something mankind has never known before, something that means one more step upward in the climb up the ladder of civilization. He brings into being a new industry. Money comes to him incidentally, if his invention is worth while, but the inventor's truest reward is knowing the joy of creation. I can think of no greater satisfaction."

A RADIO PORTRAIT

The horizontal lines composing the above picture are grouped 50 to the inch

BETTER REPRODUCTION

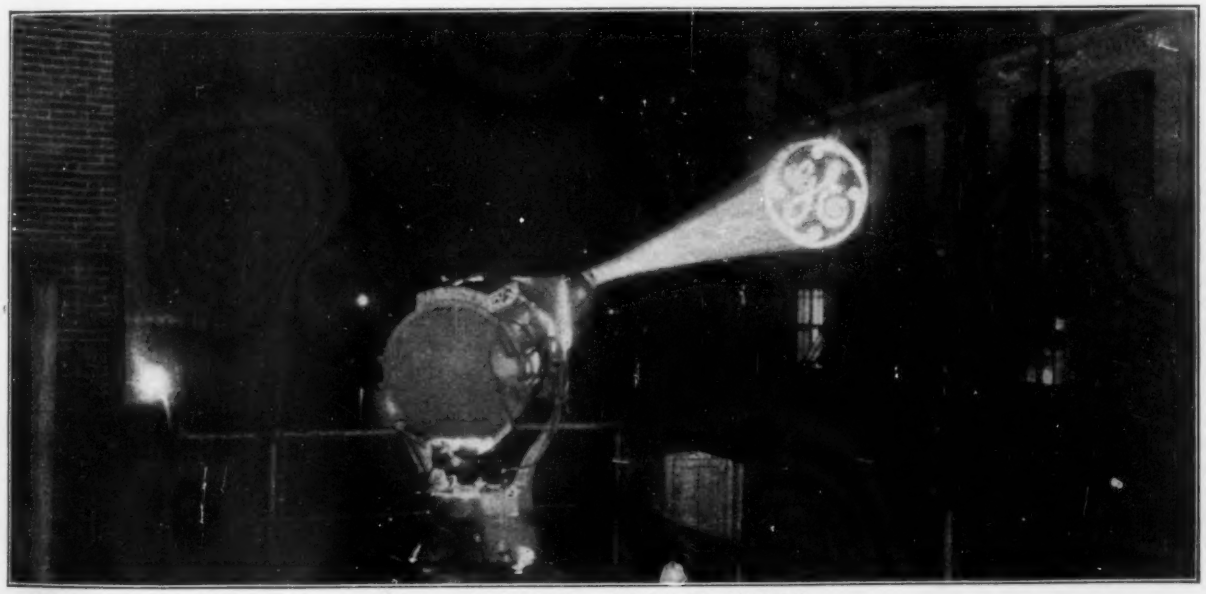
This portrait was recorded using 100 horizontal lines to the inch of surface



Photographs courtesy General Electric Company

THE AERIAL-SIGN PROJECTOR

At the rear of the cannon-like apparatus is located the 18-inch searchlight that furnishes the illumination for projecting pictures, signs and the like through a series of lenses to natural clouds or smoke-screens created for this purpose

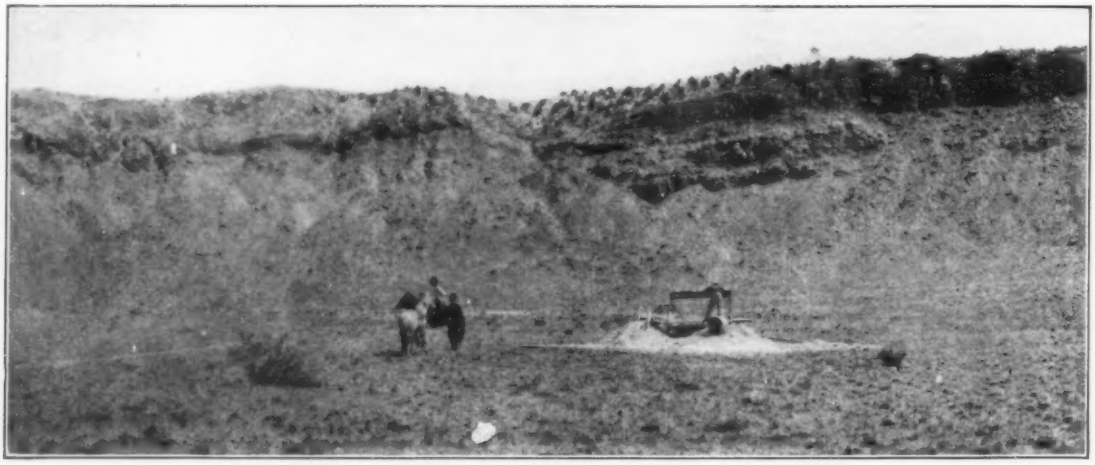


THE SEARCHLIGHT "GUN" IN ACTION

In the case illustrated, the "gun" is trained on the side of a nearby building. The lenses used are arranged so that the sign will be in constant focus at any point 20 feet or more from the "gun," thus eliminating the necessity of focusing

Sky-Painting with "Light Gun"

To be used for advertising and display purposes, a new long-range projector for photographs, drawings, signs and so forth has been developed by W. D'Arcy Ryan, director of the illuminating engineering laboratory of the General Electric Company. Essentially, the device, in its present laboratory form, consists of a powerful searchlight mounted behind a series of lenses and a slide holder. The two latter components are encased in a housing which, in shape, resembles a cannon. According to the inventor, the "gun" illustrated is only a small one and he confidently predicts that soon similar projectors of a larger size will be developed. These, it is said, will be capable of projecting images for a distance of five miles. The apparatus is designed for casting these images on a cloud bank, so that they will be visible for miles around. A lens arrangement makes focusing unnecessary, so the image can be shifted quickly from one point to another. When it is desired to make use of the wide-spread advertising ability of the device, and no clouds are available, it is planned to create artificial clouds by exploding smoke-bombs at proper intervals. The images from the projector will then be thrown on this opaque mass. A revolving screen in front of the muzzle of the projector can be used to produce color-changing effects. This glorified "magic lantern" can also, as illustrated above, be used for projecting its message on the sides of buildings and the like. It is thus apparent that the "light gun" will be very flexible for advertising purposes.



THE RIM OF METEOR CRATER, ARIZONA, FROM WITHIN

The strata on the left were tilted up nearly vertical when the great projectile struck them. Those at the right were left horizontal but were raised bodily 100 feet; this is the "arch." Between them there is a fault line concealed by debris. Compare this illustration with the map of Meteor Crater, published in last month's installment

The Most Fascinating Spot on Earth---II

The Immense Comet Buried Beneath Meteor Crater Doubtless Contains Tons of Precious Metals

By D. MOREAU BARRINGER, Jr.

AN intensive study of the physical features of Meteor Crater was next undertaken, with the hope of finding some clue as to the direction of approach of the meteorite—for it was now obvious that it had not fallen vertically after all. Largely by accident, my father observed one day that by firing a rifle into mud he could make an excellent replica of the Crater, and, moreover, that the rifle need not be fired vertically downward, but might be held even less than 45 degrees from the horizontal. Naturally one would suppose that a shot at such an angle would make an elongated hole. But it will not. The hole will be just as round as though the shot had come straight down, although the projectile will lodge under one edge of the hole instead of in the center. A charge of shot fired from a shotgun at close range will produce the same effect.

A STUDY of the interior walls of the Crater finally revealed an important fact. As I have mentioned before, the rocks exposed in the walls dip radially away from the hole. But this dip is quite variable. (See map of the Crater, published in last month's issue.) If a line be drawn through the center of the Crater, about ten degrees west of north and east of south, the dips will be seen to be curiously symmetrical with respect to that line. Starting at the point where the northern end of the line strikes the rim of the Crater, and proceeding in either direction around the Crater toward the south, the dips increase from five degrees up to about 60 degrees, which angle they attain at two points, each about 120 degrees around the hole from the starting point. Then, on either side of the Crater, there are blocks of the rim, one about 300 feet long and the other about 500 feet long, where the rocks dip approximately 90 degrees. Between these two blocks, and completing the circle on the south, is a 2700-foot section in which the dip is again as low as five degrees, that is, the rocks in the cliffs are lying practically horizontal.

TYPICAL SHALE BALL

About natural size. It is now entirely converted into nickel-iron shale

This last section is in the form of a wide, flat arch, its center being about south 10 degrees east of the center of the Crater, with its ends abutting the sections of vertical strata on either side. The rocks in the center of this arch are raised about a hundred feet above normal.

NOW let us look at these dips with the idea in mind of a projectile plowing downward and southward through the rock. The simile of a plow is not a bad one. When a plow just scrapes the surface, the ground is not much disturbed or uplifted. The deeper it goes, the more it raises and bends back the ground above and beside it. Similarly, supposing the projectile to have entered the ground near the northern edge of the present hole, we find the rocks there relatively little disturbed or uplifted. The farther south we get, and the deeper the projectile gets, the more it has bent back the rocks on either side of it. Eventually its lifting force is spent. It slips under the southern edge of the hole, raising and doming the rocks above it, but lacks the energy to throw them aside, as it has thrown aside the rocks farther north.

The observed symmetry of the dips so well fits this theory of the direction of approach that further corroboration seems almost unnecessary. But there is plenty of it to be found. The north rim is lower than the south. This is

due in part to the lower dip of its strata, but chiefly to the fact that a far smaller volume of excavated material has been deposited on the north. The amount of this ejecta increases progressively toward the south, on both sides, until the greatest volume is found on the southern rim, where the arched and uplifted strata are. The largest individual blocks of ejected rock are found in two groups, one on the east and one on the west side of the Crater. This effect can be duplicated with the rifle and mud experiment.

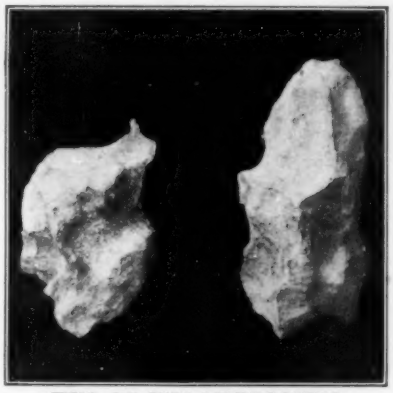
Only on the southern rim is there found any trace of the lowest ejected rock—the brownish red and lowest member of the Coconino sandstone. This is quite in order, for the projectile did not reach the depth at which this rock lay until it was close to the present southern edge of the hole. Various other indications of this symmetry along a diameter of the hole running north ten degrees west could be cited.

Chiefly for lack of funds, this theory of the direction of approach of the meteorite was not acted upon until 1920. In that year, a prominent mining company took a lease on the property for the purpose of exploring it. They sunk a churn-drill hole on the southern rim, as near as possible to the center of the great southern arch.

THE sinking of this hole was attended by many difficulties, but eventually it reached a depth of 1376 feet, where the drill became permanently stuck. But valuable information was nevertheless obtained from the work. Starting at a depth of some 1200 feet, small fragments of oxidized meteoric material were encountered, admixed with the shattered sandstone. As the hole got deeper, this material increased rapidly in quantity, until near the bottom of the hole it was comprising some 75 percent of the ground. In all respects it answered the description of the oxidized meteoric iron found at or near the surface. Now it would have been manifestly impossible for any small amount of this material to drive itself to this depth into the rocks beneath the cliffs. To enable any meteoric material to get to such a position, the whole mass must have plowed a way for it.

In other words, it is almost certain that the drill is now in contact with some part of the main meteorite, or rather the main cluster of meteorites.

Unfortunately, this mining company had greatly exceeded the estimated cost of drilling the hole, and was unwilling to go to the further very large expense of sinking a shaft to explore the meteorite. They therefore abandoned their lease. There the matter rests today, but it is shortly to be reopened.



TWO OF THE METEORITES

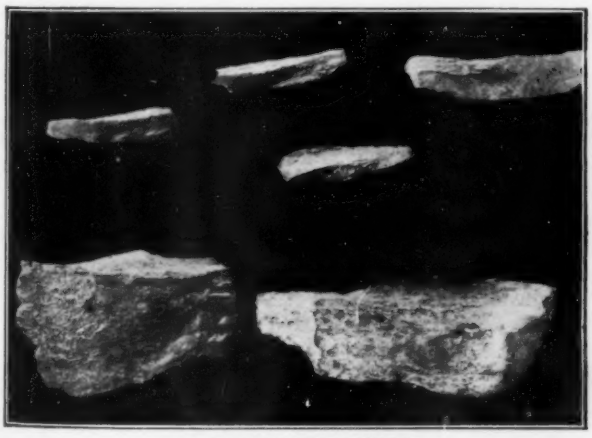
Pieces of ordinary small Meteor Crater meteorites, several pounds in weight

Having thus briefly described the history of the enterprise, it may be of interest to give a description of the character of the meteorite itself, insofar as it can be deduced from the evidence at hand, which is not scanty.

Of the pieces of meteoric material found at or near the surface the best known, of course, are the chunks of solid nickel-iron, known as the Canyon Diablo meteorites. They are to be found in every large museum. They are irregularly shaped blocks of metallic nickel-iron, with the surface, as is characteristic of many iron meteorites, looking as though thumb-marks had been made all over it when it was soft. When cut they reveal a bright, silvery surface, which will rust only very slowly or not at all. If this surface is etched with acid, the so-called Widmanstätten figures of crystallization are plainly seen. The composition of this unoxidizable iron is roughly as follows: iron, 92 percent; nickel, 6 percent; carbon (both crystalline and graphitic) phosphorus, et cetera, 2 percent; cobalt, copper, et cetera, traces; platinum, iridium, palladium, and other metals of the platinum group, about four tenths of an ounce per ton. The pieces so far found, numbering many hundreds, range in weight from less than an ounce to about 1400 pounds.

During the earliest explorations conducted by my father and his associates, they discovered large quantities of what they termed "iron shale." This occurred in pieces from less than an ounce to 300 pounds in weight, and its distribution was about the same as that of the metallic pieces. It is composed of iron oxides, and, allowing for the addition of some 30 percent of oxygen and water, its composition is identical with that of the metallic iron. It has a shaly or laminated structure, which gave rise to the name.

Very frequently this iron shale, instead of occurring as flat pieces, was found in the form of round, oval, or pear-shaped bodies, laminated concentrically, and ranging in diameter from an inch or so to three feet or more.



THE CURVED SHALE

Pieces of dense, hard nickel-iron shale, found on all sides of the Crater in great numbers. Their peculiar curvature indicates that they represent portions of shale-ball meteorites which have disintegrated, as described in the article. The smallest specimen shown is half an inch thick

TYPICAL SHALE BALLS

They have nickel-iron centers. Two of the specimens have been sawed in half. The Widmanstätten figures which are characteristic of iron meteorites show clearly on the original photographs, but not in the reproduction, as they are somewhat lacking in contrast. Greatly reduced in size

HURLED BY A GIANT FORCE

One of the very large, half-buried fragments of limestone thrown out on the western slope of the Crater, by the meteor

THE INNER RIM OF THE CRATER

The outcrop of the slightly tilted upper red sandstone and the limestone beneath are plainly visible in the foreground

These were termed "shale balls." Nearly every piece of the iron shale not in the form of these balls shows evidence, by its curved structure, of being simply a fragment of a shale-ball that has been broken up by the forces of oxidation and erosion. We may safely assume, therefore, that all the oxidized material we now find was once in the form of shale-balls.

When these shale-balls were found imbedded in the flour-like dust from the crushed sandstone, which forms a part of the rim and which is almost water-proof, they frequently contained a center or core of metallic iron. In most cases this core oxidized rapidly on exposure to the air, because it contained up to two-tenths of one percent of chlorine. But occasionally there would be found, in the interior of one of these shale-balls, one or more pieces of iron which contained no chlorine, and which was therefore unoxidizable, just as the common Canyon Diablo meteorites are unoxidizable. Only recently one of the workmen told me that he once found a shale-ball weighing over a hundred pounds, which yielded, when broken up, eleven small iron cores. I have found three in a small shale-ball weighing less than three pounds.

SEVERAL of the unoxidized cores of shale-balls have been sawed across, and then allowed to rust. In two cases, at least, there has appeared on this surface an area which refused even to tarnish, but kept its silvery appearance as bright as the day it was cut. And in each case the outline of that area resembled the outline of an iron meteorite—that is, it showed the shallow concavities which mark all the metallic pieces found at the Crater.

These unoxidizable nucleii are identical in all respects with the typical Canyon Diablo meteorites, a fact which has led my father to the belief that all the Canyon Diablo meteorites were once similar nucleii in much larger shale-balls. This theory is further borne out by another point, namely, that of their shape. This, as I have said before, is of the greatest irregularity. Their surfaces, however, all tend to exhibit the so-called "thumb-marks" or shallow depressions, which are well shown in the upper illustration on page 145. On the other hand, the shale-balls invariably have a rounded shape. This immediately suggests the shape of cobblestones in a creek-bed. The only two ways in which they could have attained this shape are by being abraded from without, or by being fused and "dripped," as molten lead is dripped to form shot. We know that they could not have been molten, for all the pieces of iron and even some of the shale show the Widmanstätten crystallization figures, which completely disappear when the iron is heated to 1500 degrees, Fahrenheit. Therefore they must have been bumped and rubbed into their rounded shape—and this could only have been done by other pieces of iron, floating near them in space.

SLIGHTLY TILTED STRATA

Part of the interior wall of the Crater, on northwest side. At this place the strata are slightly tilted, as indicated on the map published with the first installment of the article

Imagine a dense cloud of pieces of iron, flying through the interplanetary space within our solar system. Their own gravitational force, slight though it is, holds them together, but the far-off pull of passing planets, and their changing position relative to the sun, cause slight but constant readjustments in the swarm. At every contact of two of the pieces, an infinitesimal corner is knocked off or flattened. Given many millions or even billions of years for this process to continue, the members of the swarm will all have assumed a rounded shape. The tiny particles rubbed off, perhaps of hardly more than molecular dimensions, travel with the swarm, until the cluster approaches relatively close to the sun, when they are pushed out in the direction away from the sun by the pressure of its light.

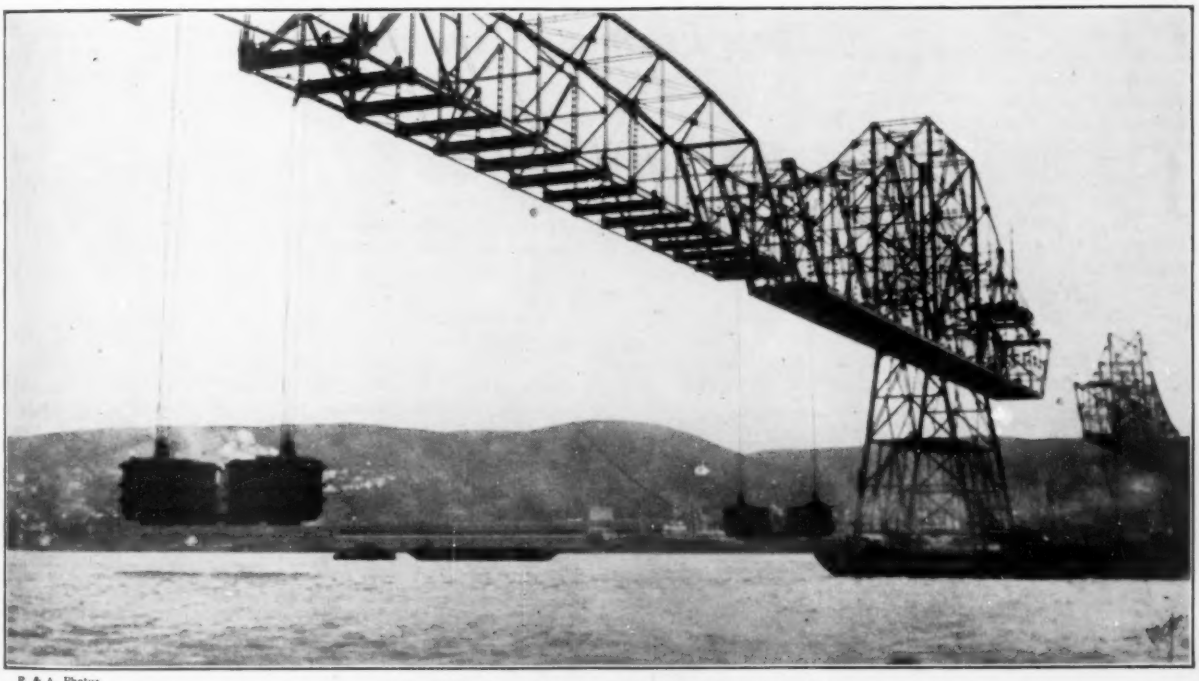
The majority of astronomers now believe that comets are just such swarms of rounded iron meteorites, traveling closely together, and sending out a tail of finely divided material when the pressure of the sun's light becomes sufficiently great. Both the comet and the tail, of course, are luminous only by reflected light from the sun, for both are probably at a temperature very close to absolute zero (−458 degrees, Fahrenheit). I think there can be little doubt that the mass which, in striking the earth, produced Meteor Crater, was a typical comet, although possibly a small and relatively dense one.

¶ *In his third and last installment Mr. Barringer will show how the size and composition of the buried comet can be deduced from the available evidence.*

P. & A. Photos

THE COMPLETED CARQUINEZ BRIDGE

View looking through the new automobile toll bridge, Contra Costa, California, which was recently opened to traffic. The bridge, which took four years to build and cost over eight million dollars, provides a broad thoroughfare for automobiles



P. & A. Photos

LIFTING A SPAN BY COUNTERWEIGHTS

Instead of lifting the span by winches carried on the cantilevers, four large boxes, weighted with sand, were used to balance the span. The lifting cables passed over sheaves carried on the cantilevers, and were attached to ends of the suspended span

Something New in Bridge Building

The phenomenal growth of automobile traffic was one of the main incentives to the building of the handsome Carquinez toll bridge, north of San Francisco. It is claimed that this is the largest automobile highway bridge in existence. It has been under construction for four years at a total cost of over eight million dollars. As will be seen from the illustrations, it is a cantilever structure of the standard American type, made up of box and latticed members, eyebars, and with wide panels. Although the bridge presents no striking novelties in its design, a distinctly new method was adopted in raising the suspended span into place. Hitherto it has been customary to float the span into position below the bridge on the deck of large pontoons and lift it into place by cables operated by motors situated on the cantilever ends. In this bridge, the lifting was done by means of heavy counterweights, whose cables passed over sheaves carried at the ends of the cantilevers.

LINDBERGH'S RYAN MONOPLANE

This is the famous plane, which, equipped with a Wright Whirlwind air-cooled engine, made the first non-stop flight from New York to Paris. The flying time was less than 34 hours

Air-Cooled Engines For Aircraft

An Historical Survey of the Design and Development of These Engines in America

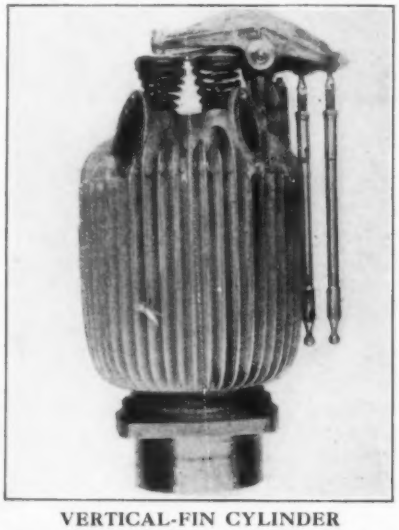
By ROBERT INSLEY

Assistant Chief, Power Plant Section, Engineering Division, Air Corps

THE 20-year war between the supporters of air-cooled and water-cooled aviation engines is rapidly dying out with the desertion of most of the water-cooling adherents to the ranks of the enemy. The air-cooled engine is very definitely in the ascendency and apparently is shortly to become the predominant aircraft power plant. This is not at all surprising. Air is the obvious cooling medium for an aircraft engine. The interposition of the more tractable intermediate cooling medium between the cylinders and the air has been in the nature of a makeshift, serving our purpose until we could learn how to use direct air cooling.

IT does not follow that the water-cooled engine must now be considered obsolete. The suitability of the air-cooled engine for all types of aircraft and all conditions of service has by no means been proved. For all conditions of service likely to be encountered at present, or in the near future, it appears now that the air-cooled engine can demonstrate its superiority. But our aviation engine development in the past has consisted simply of design refinement and utilization of better materials. There has been very little change in the fundamental operation of the engines. Whether that plan of development is continued, or some drastic fundamental changes, resulting from our present experiments with superchargers, two-cycle engines, fuel injection, and the like, are adopted, future development is certain to bring with it higher speeds, higher temperatures and consequently more exacting cooling requirements. Whether or not air cooling can keep abreast of such development remains to be seen.

The first successful aviation engines were water-cooled. The remarkable five-cylinder radial engine designed in 1901 by Charles M. Manly for Langley's experiments and the Wright Brothers' four-cylinder engine with which they accomplished their first flight in 1903 were both water-cooled. The air-cooled engines, however, were close behind. It was with a 24½ horsepower Anzani air-cooled engine that Bleriot first crossed the English Channel in 1909.



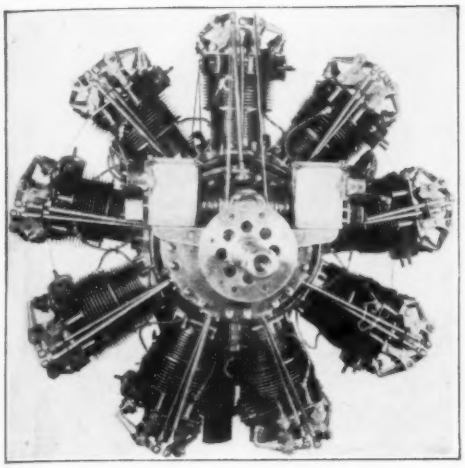
VERTICAL-FIN CYLINDER

In this type the head is integral with the cylinder, but it was abandoned in favor of a type using a head screwed and shrunk onto the barrel

The first Curtiss engines were air-cooled. There was no dearth of air-cooled engines nor lack of interest in the type, but the water-cooled engine, because of its relatively simple design problems and because of the enormous assistance contributed by the parallel development of the water-cooled motor-car engine, advanced much more rapidly.

THE war provided impetus for the air-cooled engine. The rotary engines, the Gnome, LeRhone and Clerget, as the lightest examples of air-cooled power plants, were built in enormous quantities—to be unceremoniously discarded after they had served their emergency. The rotary engines, while they performed valuable service during the war, contributed little to the advancement of the air-cooled engine. Their inherent faults—windage loss, gyroscopic effect, difficulty of control—resulted in their early demise. We can therefore safely regard the progress of the fixed air-cooled engine, both radial and line types, as representative of the development of the air-cooled engine in general. The pioneers in this work were the Renault, Anzani and Curtiss Companies.

The Renault 70 and 80-horsepower

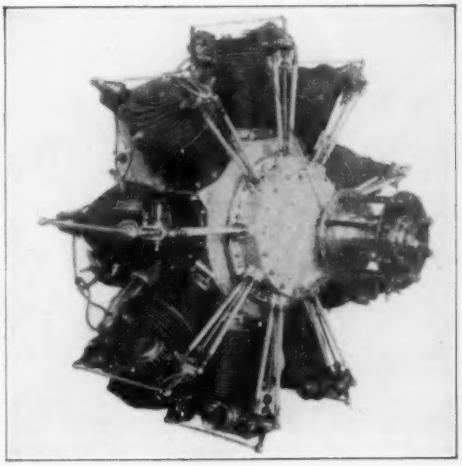


WRIGHT TYPE R-1

LEFT: *Several test runs of this engine showed its weak points, and it was completely redesigned, to appear in rebuilt and improved form under the type designation R-2*

WRIGHT TYPE P-1

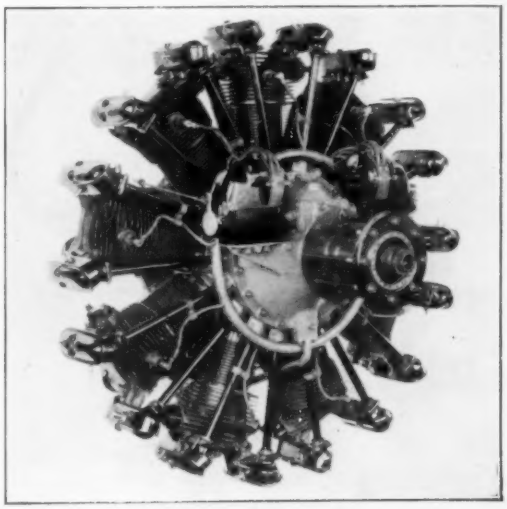
RIGHT: *This engine makes use of an unusual type of valve-operating mechanism employing push-pull rods across the tops of the cylinders. These are plainly shown in the reproduced photograph*



engines, while exceptionally sturdy and dependable power plants, could boast of little in the way of cylinder performance in comparison with the performance of contemporary water-cooled engines. Their performance was about what should be expected of their cast-iron, side-valve cylinders and blower cooling. An early Royal Aircraft Establishment development was the R.A.E. 4A, a 12-cylinder, vee, 140-horsepower air-cooled engine with cast-iron, side-valve cylinders. The bore of the 4A engine was 100 millimeters and the stroke 140 millimeters. The cylinder performance, 85 pounds per square inch brake mean effective pressure, although an improvement over that of the Renault cylinders, was still considerably lower than the performance of the best water-cooled engines of the time, although the engine was extremely dependable.

THE R.A.E. 4D engine, which was produced early in 1917, differed from the 4A engine principally in cylinder design. The 4D cylinder consisted of head and barrel of cast aluminum, into which an open-end steel liner was shrunk. The steel valve-seats were cast into the head. In this cylinder the side valves were replaced by overhead valves and the upper half of the combustion chamber was of spherical form. In performance the 4D cylinder showed a marked superiority over the 4A, producing a brake mean effective pressure of approximately 108 pounds per square inch. Although the 4D engine was never put into production, the success of the cylinder indicated the possibilities of improvement of air-cooled cylinder performance by such design investigations. The R.A.E. 4A engine was the last of the air-cooled vee engines produced in any quantities, and with that engine the vee type was entirely abandoned in air-cooled engine development until its revival by the United States Army Air Service in 1923 in the form of the air-cooled Liberty.

The cylinder studies by the Royal Aircraft Establishment continued with the design and test of a large number of air-cooled cylinders of various types and materials in sizes up to eight-inch bore and ten-inch stroke. The 4E cylinder was a modification of the 4D, with larger valves and with four instead of two hold-down bolts. Both the 4D and 4E cylinders, however, suffered from poor thermal contact between the steel liner and the aluminum barrel. This difficulty led to the development of cylinders with all-steel barrels, both open and closed ends, with various types of heads.



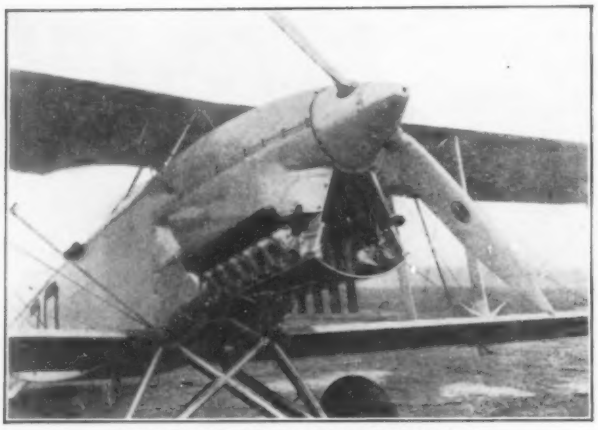
WRIGHT TYPE J-5

This sturdy engine, known as the Whirlwind, is the type used in the famous Ryan transatlantic monoplane illustrated at the top of the opposite page

The A.B.C. cylinders for the Wasp and Dragonfly engines were constructed with a one piece, closed-end steel barrel, a flat head, valve seats machined in the steel head, two exhaust and one intake valve, and separate cast-iron and aluminum valve-ports attached by studs to the cylinder head. As might be expected, these cylinders had very poor head cooling, the valve life was very short and the fuel consumption necessary for most satisfactory service was excessive. To correct these troubles, the R.A.E. 21T cylinder and the 21TD, differing from the 21T in details only, were designed.

The 21TD cylinder consisted of an aluminum head cast on an open-end steel barrel. The head was spherical and single intake and exhaust valves were used. The valve seats were cast into the aluminum head. Test results showed these cylinders to be much more successful than the earlier type, but difficulty was experienced in obtaining satisfactory bonding between the head and barrel. A modification of this type, in which the cast-aluminum head was bolted rather than cast to the open-end steel liner was considered unsatisfactory because of insufficient thermal contact at the joint.

A later British development, the cylinder type to which American air-cooled engine progress is most directly indebted, was the open-end steel barrel with cast-aluminum head screwed and shrunk on the barrel. In this cylinder, the valve seats were cast into the head. The spherical combustion chamber with single intake and exhaust valves was very similar to that of the R.A.E. 21TD cylinder. This type of cylinder was used first on the Siddeley radial but is now in general use in modified form in England and the United States, on all types of air-cooled engines. The British development of the air-cooled cylinder continued, of course, beyond this point, but the steps mentioned formed in general the foundation on



INVERTED AIR-COOLED LIBERTY

For purposes of easier installation and repair, this engine was designed for operation in the inverted position shown

CURTISS "HAWK" WITH LIBERTY ENGINE

This side view of the plane and engine shows the exhaust pipes and the location of the covers over the valve mechanism

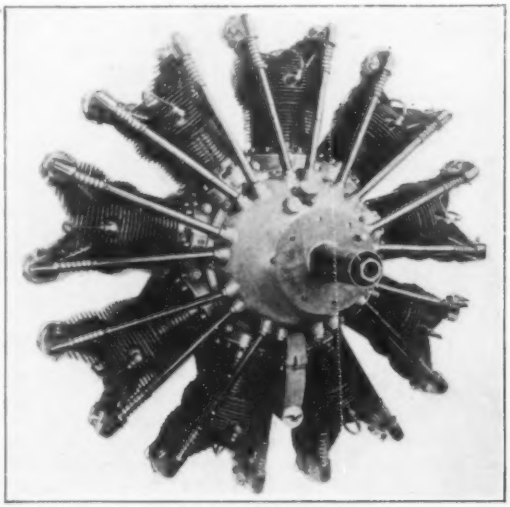
which the larger part of American air-cooled engine progress has been built.

During the period of the war and immediately afterward there was in the United States very little air-cooled engine development worthy of the name. However, in 1916, Charles L. Lawrance produced the Lawrance A-3, a 28-horsepower, two-cylinder, air-cooled engine used to some extent in "penguin" training machines. His model B, also produced in 1916, was a three-cylinder, radial type with cast-aluminum cylinder head and barrel, with steel liner pressed into the barrel. His cylinder construction was very similar to the R.A.E. 4D cylinder.

IN 1920, after attempting unsuccessfully to interest several other aircraft-engine manufacturers in air-cooled engine construction, the Engineering Division of the United States Army Air Service undertook a definite program of air-cooled development by the announcement of a competition for the design and construction of an air-cooled, radial engine for pursuit airplanes. Seven designs were submitted and finally a contract was entered into with Mr. Lawrance for the construction of four nine-cylinder air-cooled engines of 160 horsepower, to be known as the Lawrance R-1.

The Lawrance R-1 was delivered to the Engineering Division and successfully completed a 50-hour test in 1921, the first American air-cooled engine to successfully pass such a test. Fifty of these engines, enlarged in capacity, but identical in other details (called the Lawrance J-1), were purchased during the same year by the United States Navy for training purposes. The Lawrance R-1 engine was the starting point for the development of the first American production of air-cooled aviation engines. It has been developed over a period of five years and is now represented by the highly successful Wright Whirlwind type J-5 engine. This engine was used by Captain Charles A. Lindbergh in his Ryan monoplane in which he made his now historic non-stop flight from New York to Paris. The engine is described in detail in the section devoted to aviation notes in this issue.

The Lawrance R-1 engine cylinder was similar to that of the Lawrance model B engine with cast-aluminum head and barrel, pressed-in cylinder liner, relatively flat head, two valves and cast-in valve seats. This general cylinder construction was continued with only detail changes until, in the J-4 model, the upper end of the cylinder liner was threaded and screwed into the aluminum casting. The cylinder construction was again changed in the J-5 model and a spherical-head cylinder, developed by the Engineering Division of the United States Army Air Service, was substituted for the J-4 type.



THE "WASP"

In high-speed performance, this 1340 cubic-inch engine has many excellent characteristics

In 1922 the Wright Aeronautical Corporation delivered the Wright R-1 engine, fitted with the Engineering Division type J cylinder. The first 50-hour test of this engine was terminated after 47 hours through failure of the master connecting rod. A duplicate of this rod was modified slightly, the compression ratio increased to 5.4 to 1 and the 50-hour test repeated. The second test was terminated after 43 hours through piston and crankshaft failure. Following this test, the engine was rather generally re-designed and rebuilt for the third 50-hour test, which was terminated in preliminary calibration runs through piston failure.

ON the basis of these tests, a contract was written with the Curtiss Aeroplane and Motor Company for three R-2 engines to be similar in general construction to the rebuilt R-1. This engine incorporated a built-in rotary induction system, type M cylinder and special crankpin lubrication system. This engine recently passed its 50-hour test and is now in service test status. The type designation of the engine has been changed to Curtiss R-1454. This engine represents the first American application of the rotary-induction system which has since been incorporated in all of the larger air-cooled engines.

Coincident with the competition for air-cooled radial engines, the Army Air Corps initiated a series of tests of air-cooled cylinders similar to the tests conducted at the Royal Aircraft Establishment. The cylinder investigation at the Engineering Division started with what now seem grotesque

examples of air-cooled cylinders. The early tests were conducted largely with cylinders composed of aluminum heads and barrels cast on steel cylinder-liners. Bronze valve-seats cast into the heads were used in nearly all of the early tests. The types of construction tested included axial fins, circumferential fins, bolted-on heads, integrally-cast heads, roof heads, flat heads and other minor modifications of design. All of these types for one reason or another were unsatisfactory and the later development has been concentrated on the cast-aluminum head screwed and shrunk onto the forged steel barrel.

The first three of the cylinders with screwed-on heads were designed to investigate the relative value of two, three and four valves and of roof-head, flat-head and spherical-head cylinders. The H cylinder was a four-valve roof-head cylinder, the I a three-valve, flat-head cylinder and the J a two-valve, spherical-head cylinder. The results of tests showed the spherical head to be superior to either of the other types from the point of view of cooling, and two valves to be entirely adequate for cylinders of this size, (five and five eighths by six and a half inches). The development was continued with the J cylinder.

IT will be impossible in this article to discuss in detail the development of the air-cooled cylinder by the Engineering Division, but the principal results may be briefly stated as follows:

a. First development of high mean effective pressure air-cooled cylinders. "High mean effective pressure" in this instance refers to brake mean effective pressures in excess of 130 pounds per square inch, maintained over long periods of operation.

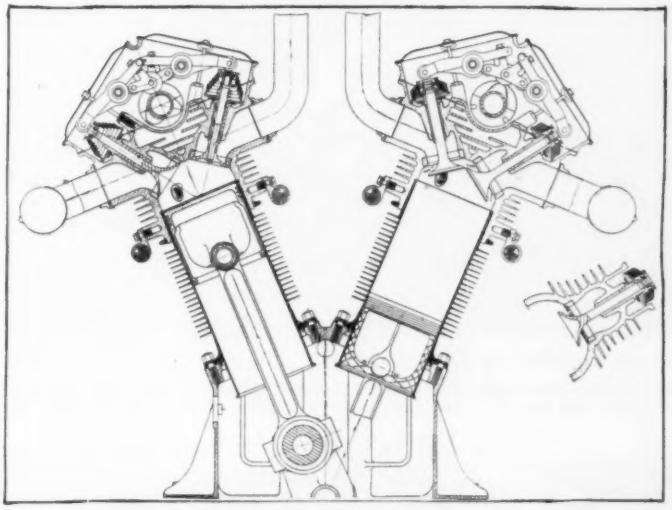
b. Development of the shrunk-in, aluminum-bronze valve seats. While this may appear to be unimportant, no more than a glance at the troubles that have attended the use of cast-in, rolled-in and peened-in seats and the general adoption of the shrunk-in aluminum-bronze seats in cast-aluminum heads is required to prove its value.

c. The development of the enclosed valve gear for air-cooled aviation engines. This type is represented in the K and M cylinders. The advantages are complete oil-bath lubrication of the valve gear, with consequent elimination of wear, partial compensation for valve clearance, retention of push rods when a valve spring fails, and protection of valve gear from the effects of exposure (particularly desirable in operation in the vicinity of salt water).

d. The development of a foundry practice and the commercial application of special alloys for cylinder-head castings.

e. The investigation of valve cooling and valve materials and the development of properly proportioned salt-cooled and standard valves for air-cooled engines.

f. The vindication of the large, two-valve, air-cooled cylinder. The Engineering Division two-valve X cylinder with 188 cubic-inch displacement develops 133 pounds per square inch brake mean effective pressure at 1800 revolutions per minute; approximately 166 pounds indicated mean effective pressure.



TRANSVERSE SECTION OF AIR-COOLED LIBERTY

This was one of the first vee-type Liberty engines to be designed and built for air instead of water cooling

Shortly after the successful completion by the Wright R-1 engine of the larger part of a 50-hour endurance test, the Wright Aeronautical Corporation, at the request of the United States Navy, began the development of a large air-cooled radial of approximately 400 horsepower, designated the Wright P-1 engine. This engine employed the screwed and shrunk aluminum-head cylinder with, however, an unusual type of valve mechanism in the form of a push-and-pull rod across the top of the cylinder. The engine has been developed through several models, but its general acceptance as a service type has been delayed by a series of unfortunate incidents encountered during its experimental development.

The latest entry into the air-cooled radial field, representing a very creditable bit of engine design, is the 9-cylinder, 1340 cubic-inch Pratt-Whitney Wasp. In many particulars, this engine is superior to any air-cooled radial previously in existence. Its actual test-development-to-production status has been accomplished in a remarkably short time. Its performance characteristics, particularly in the matter of smoothness and high-speed performance, are excellent. It has a bore and stroke of five and three-fourths inches, and a piston displacement of 1340 cubic inches. It is rated at 400 horsepower at a normal speed of 1900 revolutions per minute and weighs, bare, approximately 650 pounds. It employs the familiar screwed and shrunk cast-aluminum head cylinder similar to the type M developed by the Engineering Division for the R-1454 engine, but with the lower halves of the rocker box integral with the cylinder-head casting. The cylinder has a spherical head, single intake and exhaust valves and shrunk-in valve seats. The crankcase is of forged duralumin and carries a built-in rotary-induction system at the rear.

NO more than mention has yet been made of the revival by the Engineering Division of the air-cooled, vee engine last seen in the R.A.E. 4A engine in England. Air-cooled engine studies by the Engineering Division led to the belief that a high-duty, air-cooled, vee engine could be designed to operate satisfactorily and would have considerable advantage, in the larger sizes at least, over the radial type. The advantages considered at the time were reduced head area, increased smoothness, higher maximum crankshaft speeds and, chiefly in the larger sizes, installation advantage. In order to test the theory, it was decided to rebuild a Liberty engine with air-cooled cylinders and investigate its performance. It was believed that if the air-cooled Liberty, with 45 degree angle between cylinder banks, could be made to cool satisfactorily, there should be little difficulty in cooling any air-cooled, vee engine.

The first experimental engine was built in the upright type and cooled very satisfactorily through three torque-stand 50-hour tests. For airplane installation advantages, the subsequent air-cooled Liberty engines have been inverted. They have given an excellent account of themselves in flight service and, in direct comparisons with the most advanced representatives of the air-cooled, radial types in similar installations, have certainly showed (*Continued on page* 182)

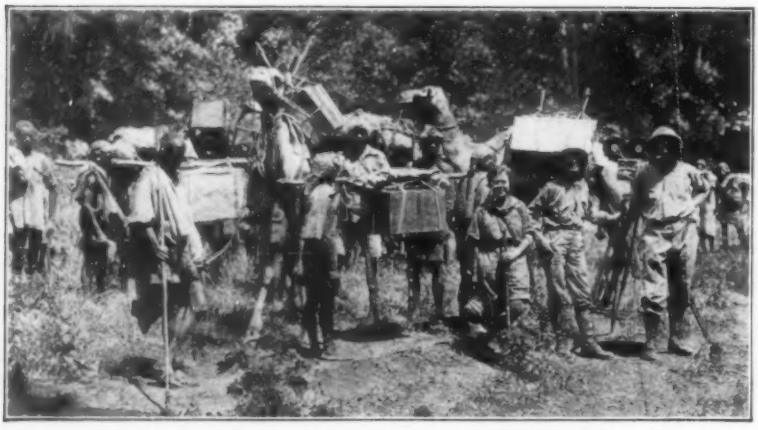
All photographs by Martin Johnson, courtesy American Museum of Natural History

AFTER A SUCCESSFUL SHOT

Mr. and Mrs. Martin Johnson, with a group of their native helpers and one of the animals which they shot

A MODERN DIANA IN AFRICA

Mrs. Johnson, an expert with a high-powered rifle, poses with an elephant that fell before her marksmanship



ON THE MARCH IN BRITISH EAST AFRICA

The members of the Martin Johnson expedition with their cameras and other equipment packed on native bearers and "African pack horses"—camels

A NATIVE MOTHER

The natives posed for the cameras for a consideration of 25 cents a day

A LEOPARD IN CAPTIVITY

This leopard poses often, for he is in the gardens at Government House, Nairobi

WILD ELEPHANTS CHARGE THE HUNTRESS

Mr. Johnson was manipulating the camera which recorded this remarkable picture. In the foreground is Mrs. Johnson with rifle ready to shoot

The Camera as an Aid to the Naturalist

The animal films and "stills" taken by Mr. Martin Johnson have never been surpassed. It would hardly be fair not to mention Mrs. Martin Johnson in the same paragraph, for she handles a gun as fearlessly, and a camera almost as skillfully, as her husband. They have just returned from a three and one half year sojourn in Africa. They brought back 200,000 feet of motion-picture film and 7,000 "still" photographs as a result of their great photographic hunt, for they believe in using the lens rather than the rifle. However, they also believe in preparedness and do not fare forth without guns. Most of their records were made on the shores of a lake on the Abyssinian border which the Johnsons named "Paradise Lake." Large numbers of wild animals from the surrounding country come there for water and forage. Mr. Johnson, in an interview on his arrival, said that there were many lions, elephants and rhinoceri, particularly elephants, which showed great fondness for the sweet potatoes in the Johnson garden. He also spoke of lions which had never heard a rifle shot and were

AT A DESERT OASIS

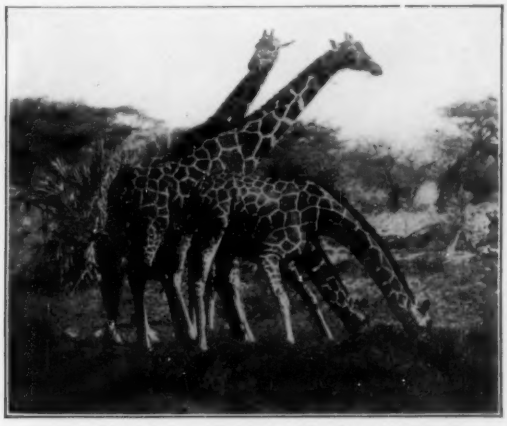
Several groups of camels gathered at a watering place, possibly to lay in a supply of water for a coming drought

WATER IN THE DESERT

Surrounded by vegetation peculiar to the locality, this water hole, or spring, is a godsend to man and beast

FILMING TYPICAL AFRICAN NATIVES

Operating an Akeley type of motion-picture camera, Mr. Johnson secured many feet of film that are now invaluable for ethnological records



GIRAFFES SEEKING WATER

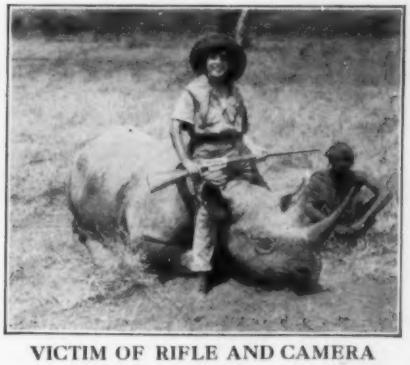
Because of the timidity of the beasts, Mr. Johnson used a long-focus lens for this picture

A JUNGLE PET

Mrs. Johnson and one of her pets, together with a native and buffalo head

AFRICAN FISH

Mrs. Johnson seems to handle a fish line as well as she does a rifle

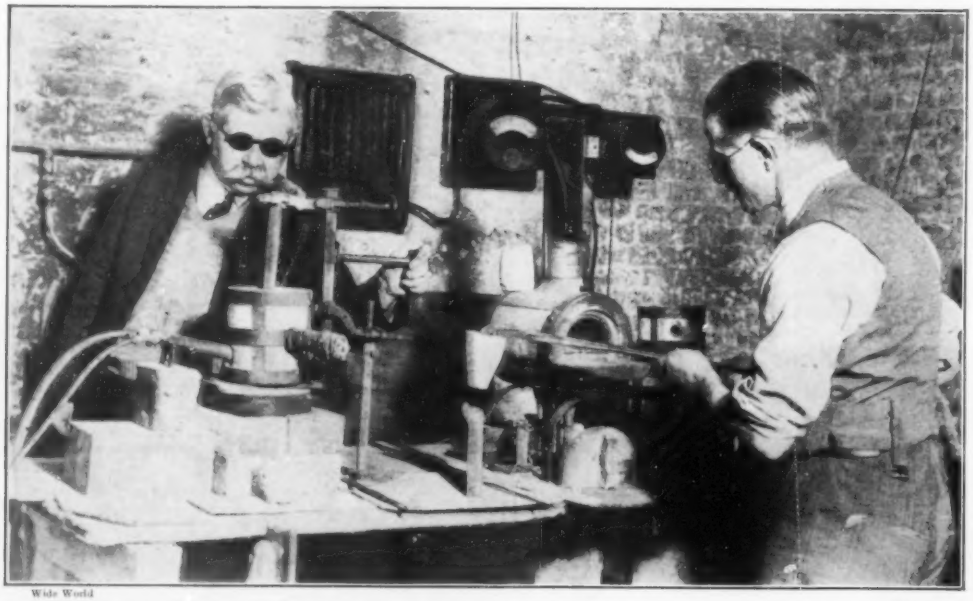


VICTIM OF RIFLE AND CAMERA

In a frivolous moment, Mrs. Johnson poses with one of the dead rhinoceri

fearless of men. Mr. Johnson said he easily made pictures of them with his still and motion-picture cameras, while Mrs. Johnson stood near by with a rifle, ready to shoot if necessary. The rifle, he said, was used rarely, and the pictures showed the animals serene and unsuspicious. The original negatives made by the expedition will be presented to the American Museum of Natural History. Their next expedition, which they expect to start soon, will be into the Congo to make pictures of the gorilla, the habits of which are still little known to scientists, and of the okapi, a curious animal which has rarely been photographed. The films shown at the American Museum of Natural History were wonderful and the lecture had to be repeated immediately to accommodate those waiting in the exhibition galleries. What proved to be most interesting was the spirit of friendliness, almost politeness, which the animals showed to each other at the drinking places. How Martin Johnson entered motion-picture work is worth recording. Jack London went to the South Seas in 1903 aboard the *Snark* and Martin Johnson officiated as photographer and cook. When the vessel touched at one of the South Sea Islands, he saw for the first time a motion-picture camera, operated by two Frenchmen. They grew tired of their job and put their apparatus in Johnson's hands. Since that time his films have had no superiors in wild-life cinematography.

From the Scrap-book of Science—



Wide World

NEW ALLOYS

Left: Dr. T. D. Kelly, English research worker, has discovered two new iron-copper combinations which show high resistance to attack by acids. A third alloy called "solium" is said to resemble platinum, although it is lighter

BIRD BANDS

Below: Laurence M. Huey, Curator, Natural History Museum of San Diego, California, has been studying bird migration habits by means of numbered metal bands placed on the legs of birds. Later the birds are trapped, recorded and subsequently released

P and A

ATOMIC ARRANGEMENT IN SALT

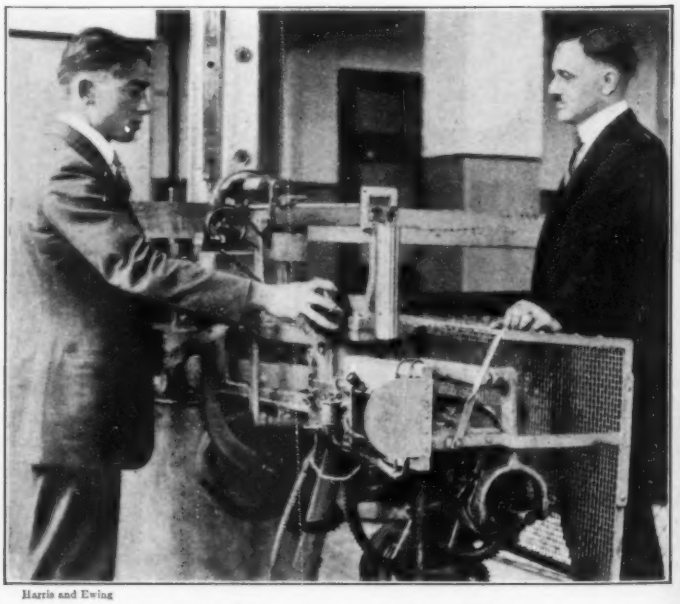
If a microscope could come anywhere near revealing the atoms—which it does not, although X rays do—the sodium and chloride atoms in table salt would look something like this model

P and A

Underwood and Underwood

NEW TEST BEATS ALIBIS

Whether a man—or a woman—has been drinking or not can be proved with this new apparatus



Harris and Ewing

HOW MUCH WILL A WOODSCREW HOLD?

A lot more than many of us think. The United States Bureau of Standards has just been finding out, by means of tests on 10,000 screws

Camera Shots of Scientific Events

WHAT NEXT?

Here is a "flivver" converted into a "yacht." The rear tires have been replaced with paddles, and "Lizzie" navigates the waters near Wintrop, Massachusetts. Mr. C. Wesley Smith is the captain of the ship as well as the owner. Has anyone tried converting a Ford into an airplane? Considering the odd things that have been done with them, we should not be surprised to hear of this

Wide World

P and A

X RAYING FOR SUSPECTED BOOZE

Out in Los Angeles, the District Attorney is well up with the times. He has equipped his enforcement men with regular X-ray apparatus with which to examine various boxes suspected of harboring "hooch." The photographer who posed this picture was obviously not an X-ray technician

Underwood and Underwood

PHOTOGRAPH TAKEN BY INVISIBLE RAYS

Prof. R. W. Wood, of Johns Hopkins University, photographed in fluorescent light from a chemical called eosin

Wide World

NEW COLOR-MATCHING MACHINE

More accurate than the human eye is the machine developed by Professors Hardy and Cunningham of Boston "Tech"

Herbert Photos

HUGE ELECTRIC LOCOMOTIVE

Now in use in Switzerland, it weighs 283,350 pounds, is 65 feet long, and has six electric motors of 4500 total horsepower

By Burton Holmes, from Ewing Galloway

PREPARING BAMBOO OYSTER-STICKS

The sticks upon which oysters are to be grown are split from large pieces, weighted at one end, and sunk in the water

By Burton Holmes, from Ewing Galloway

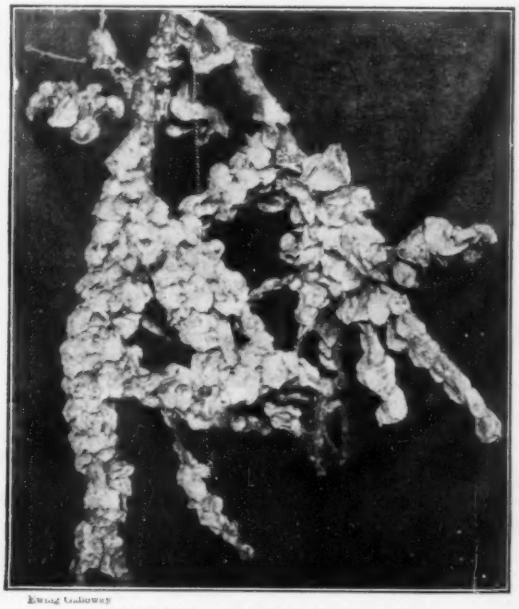
WHERE THE OYSTERS ARE COLLECTED

At this station in Formosa, the half shells are left on the ends of the sticks to provide more surface for the next crop

By Burton Holmes, from Ewing Galloway

OYSTER BED AT AMPING, FORMOSA

This photograph, taken at low tide, shows part of the arrangements made by the native Formosans for the cultivation of large oyster crops



Ewing Galloway

OYSTERS ON BIRCH BRANCH

This method of cultivation provides ample room for the oysters, even when they are full grown

Oysters Now Grown On Trees

For many years, the natives of the island of Formosa have been cultivating oysters in a crude way, but it remained for the United States Bureau of Fisheries to apply modern science to the problem and provide overcrowded oysters with places where they could live and mature in comfort and with a low mortality rate. One of the prime reasons for the decrease of the oyster industry in this country has been the fact that oyster beds become so crowded that thousands of the bivalves die before they attain maturity. According to William Firth Wells, of the Conservation Commission of the State of New York, the solution of the problem resolves to one of providing clean places of attachment for the drifting oyster larvae. Coupled with this must be a method of supplying a dependable source of the larvae, and it is in this work that Mr. Wells has been engaged for the past few years. It must be understood that the first ten days to two weeks of the young oyster's life are spent in a free, floating condition, where it is exposed to many dangers. After this time, the oyster attaches itself to some stationary, clean object, and grows there for the rest of its life. If there is not ample room, the oysters crowd each other and a large majority of them find it impossible to survive. At Milford, Connecticut, birch branches are being placed in oyster beds to serve as permanent homes for oysters, and thus far the experiment is successful.

Household Inventions

Devices Illustrated on This Page Make Housework Easier

CONDUCTED BY ALBERT A. HOPKINS

ELECTRIC BAKER

This device bakes doughnuts, small cakes and breads, six at a time. Made at the table, they are ready to be eaten within five minutes

REVERSIBLE PAN

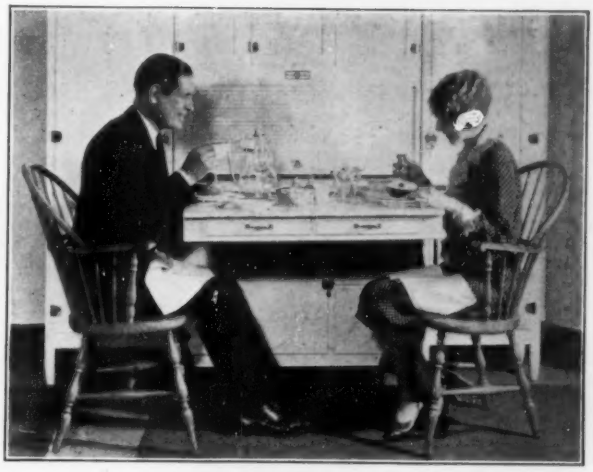
When open, this frying pan will cook two different foods. When closed, it can be used for baking on top of the stove

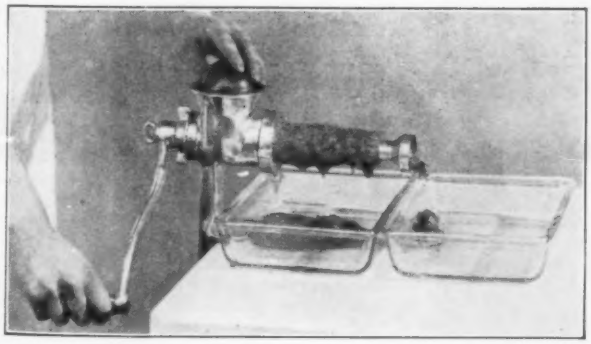
BAKING KETTLE

Aside from the usual uses, this aluminum kettle, with rack and thermometer, may be converted to a serviceable top-of-stove oven

CABINET TABLE

In the illustration at the right is shown a new type of kitchen cabinet. In this new model is incorporated a sliding table top, separate from the usual porcelain work table. This top is especially designed for breakfast use, eliminating the necessity of setting the table. Everything required for service is in its regular place in the cabinet, handy to those at the table. This model seats three comfortably





PIT EXTRACTOR

The removal of seeds and stems from the juice and pulp of fruits, as well as the pulverizing of dry materials is accomplished with the device shown

CAKE PAN

This pan is designed for use on top of the stove. A mica window allows observation of cake while baking. A hole is provided for inserting a straw

PAN HOLDER

The wire arrangement shown can be used for lifting and tilting hot pans, and for a variety of purposes

REPLACEABLE BLADES

The edge of the blade of the bread knife shown is replaceable. A thumbscrew holds the blade in position

Inventions in the Field of Sport

GOLF BALL CLEANER

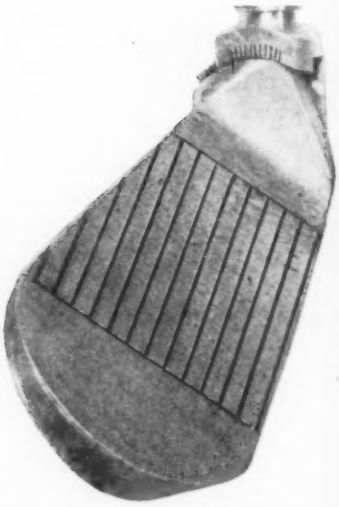
No longer will it be necessary for the golfer to get his hands covered with sand and water as he cleans his ball at the tee, providing the new ball cleaner shown in the foreground in the illustration at the left is used. With this, the ball is inserted in a slot in a vertical member, the latter is drawn up and down, and the ball revolves between two brushes. It is said that by this action the ball is thoroughly cleaned, yet the enamel finish is not harmed in the least. Carefully cleaned balls are easier to find after a long drive

SEAT FOR THE BABY

The folding seat shown above enables the child to see what is going on, at the same time keeping him out of mischief

ON THE LINKS

The adjustable club in use looks just like any other "iron"

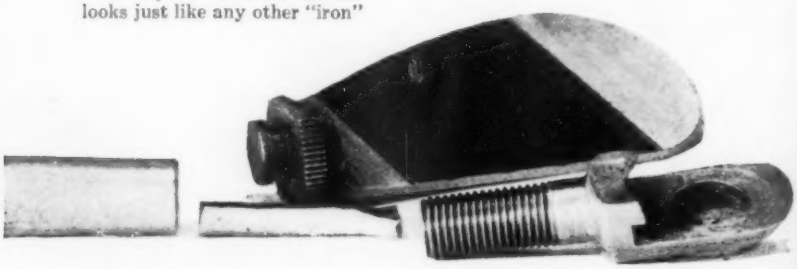


ADJUSTABLE GOLF CLUB

To eliminate the necessity of buying and carrying a whole bagful of clubs in order to play the game of golf correctly, a professional golfer has invented the improved adjustable "iron" shown above and below in detail, and at the left in use. With this club, the angle between the head and the shaft can be quickly varied, according to the "lie" to be played, yet the head cannot change its position while in use. Thus, the same club can be used as a putter or a niblick, or as any of the intermediate clubs, a twist of the shaft changing the head angle and locking the head

MINNOW BUCKET

This cover converts any ordinary pail into a minnow bucket. The cover is held in place by several metal spring clamps



SPORT UMBRELLA

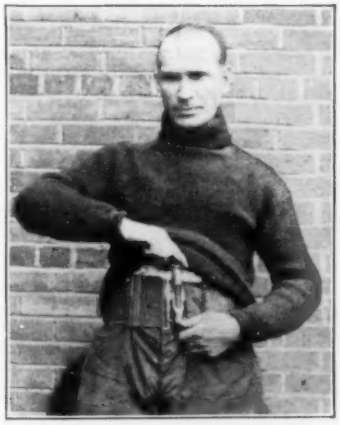
Large umbrellas made of heavy twill, and with strong frames, are now on the market, designed to be used for various purposes such as those shown at the right and below. An umbrella of this type may be securely fastened to a sport roadster to serve as an emergency top, or can be quickly removed and used as a beach umbrella. A window in the umbrella contributes toward safety. It is said that when on a car, the umbrella is not disturbed, even at high speeds. In a test conducted at a speed greater than 70 miles per hour, the umbrella stayed firmly in place, showing no tendency toward buckling or other damage

SAFETY BATHING SUIT

A series of air-inflated tubes fastened under the material of the bathing suit shown at the right makes it impossible for the wearer to sink. These tubes are composed of a heavy rubber fabric and are of such shape and size that they do not make the suit unduly bulky. Wearing a bathing suit of this type, a novice with no knowledge of swimming need not be encumbered with awkward water-wings or similar aids to the embryo swimmer

COMFORT IN THE WATER

Not one of the young ladies in the above illustration can swim, yet they are as at home in the water as if they were born to it. The reason for the ease with which they float around reading newspapers in a nonchalant manner is the bathing suit shown at the left. Wearing suits of this type, with air-filled tubes inserted, it is impossible for them to sink below the surface



LIFE-SAVING BELT

A comparatively inconspicuous belt, which can be worn without discomfort at all times when there is danger of a sudden immersion in water, is shown above and at the left and right. This belt contains an inflatable rubber portion and is equipped in the front with a receptacle containing a glass bulb filled with a compressed gas. When the belt is to be used for a life belt, a screw in the container is turned, breaking the glass bulb. The released gas immediately fills the rubber compartment, providing sufficient buoyancy

The Scientific American Digest

A Review of the Newest Developments in Science, Industry and Engineering

CONDUCTED BY ALBERT G. INGALLS

The End of the Old-Fashioned Sidewalk Bridge

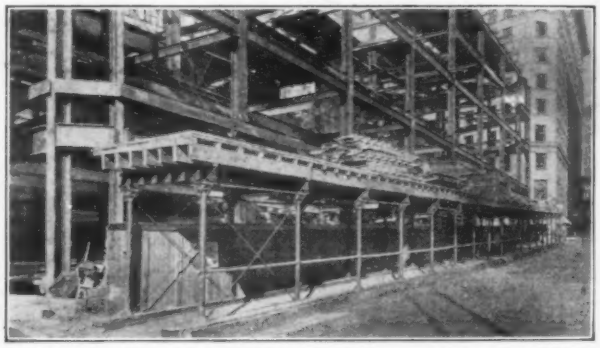
PRACTICALLY all large cities have ordinances requiring a sidewalk bridge on each building operation. In the past, very little attention has been given to providing a sidewalk-protection bridge which would combine the two vital essentials, namely, safety and good appearance. There is no time during normal business periods when there are not a great many of these structures standing on or near the city streets.

With the idea that a considerable saving could be effected if contractors used some standard steel supporting-structure to meet varying conditions found on different operations, a modern steel sidewalk-protection bridge has been developed. This can be erected and dismantled more rapidly than the old type of wooden structure. Also, compared with the old-fashioned type, it does not interfere with the orderly movement of pedestrian traffic.

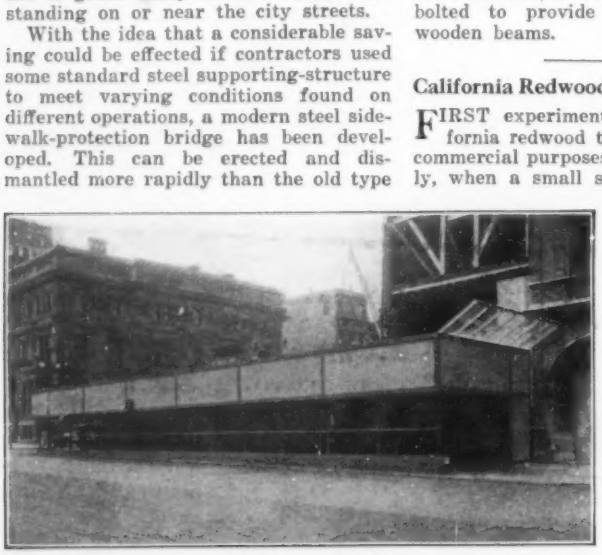
The new steel supporting-structure is constructed of standard units which can be erected in such a manner that the width of the passageway may be varied to suit conditions. The distance between columns may be varied in a longitudinal direction to provide for obstructions, driveways, et cetera, and can be erected with equal facility on level or sloping sidewalks. This condition is met by the clamp arrangements which enable the various members to be fabricated to suit actual requirements on the ground, without necessitating drilling of bolt holes.

The columns are made of four-inch steel pipe and the supporting beams are eight-inch, 25½-pounds-per-foot steel I-beams. The connecting pieces are of one and one-half inch steel pipe. On the steel I-beams, a wooden nailing strip is bolted to provide for attaching the wooden beams.

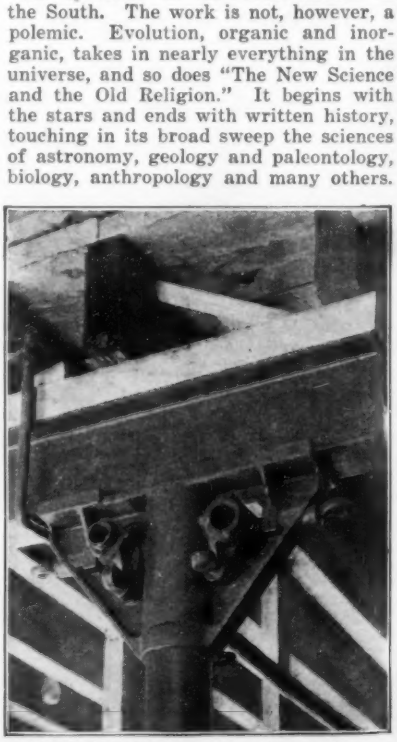
How the fence around building operations may be utilized for show cases or show windows



Steel sidewalk structures are strong, and they admit ample light to the sidewalk below



A completed sidewalk bridge. Trim and neat, it takes the place of the unsightly, gloomy wooden structures that have been an undesirable feature of building operations until lately



How the structure is clamped together. It may be dismantled, moved and set up elsewhere, undamaged

California Redwoods to be Tried in East

FIRST experiments in planting California redwood trees in the east for commercial purposes will be made shortly, when a small shipment of redwood seedlings will be set out in Natural Bridge and other national forests of Virginia, H. M. Sears, supervisor of Natural Bridge forest, has announced.

The redwood will be planted on Back Run, near Natural Bridge, in the local forest. It will be given a try-out on experimental plantations of the other Virginia preserves. The work is being done in cooperation with the state forester at Charlottesville.—*Science Service.*

The New Science and the Old Religion

IT is a long time since we have seen a book that brings together so many things of the kind that, we think, will interest SCIENTIFIC AMERICAN readers, as does Dr. Thornwell Jacobs' "The New Science and the Old Religion." Dr. Jacobs is president and founder of Oglethorpe University, Atlanta, Georgia. He is a Southerner and has obviously kept in mind while writing his book the recent epidemic of anti-evolutionism in the South. The work is not, however, a polemic. Evolution, organic and inorganic, takes in nearly everything in the universe, and so does "The New Science and the Old Religion." It begins with the stars and ends with written history, touching in its broad sweep the sciences of astronomy, geology and paleontology, biology, anthropology and many others.

The culvert "gopher" at work, driven by a gasoline engine. The jack in the foreground keeps the rig up against the work as it advances. Traffic keeps right on

As the title implies, Dr. Jacobs has not avoided religion. Far from it. His main thesis is that there is religion in science, science in religion, and between the two, nothing incompatible. The book should also be read by the intelligent fundamentalist, whom it would not offend.

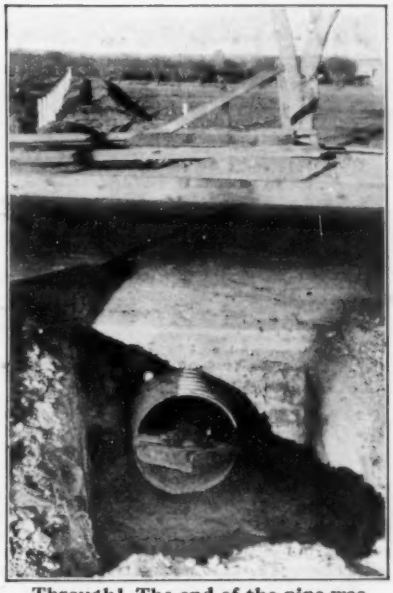
The composition and press work, it is interesting to note, were done entirely by the students of Oglethorpe University at the Oglethorpe University Press, and the work is creditable. The book is unusually well illustrated, largely by important illustrations judiciously chosen from the works of such well-known scientists as Millikan, the physicist; Hale and Lowell, the astronomers; Chamberlin, the cosmologist; Scott and Osborn, the paleontologists; Slosson, the chemist, and Haeckel, the biologist. The price is $3.75 postpaid.

Texan Invents Culvert "Gopher"

IN the past the only method for installing culverts has been to cut out half of the pavement, place one half a length of culvert and then backfill, allowing traffic to use the other half of the pavement in the meantime. In like manner the other half of the culvert was placed. It was, of course, then necessary to let traffic travel over the backfill for some time to insure its compactness before the concrete could be replaced. In order to allow continuation of traffic, only half the roadway could be poured at one time, as it was necessary for the concrete to stand several days before it had sufficient strength to carry traffic. This method was unsatisfactory.

For some time F. E. Wilson, County Engineer of El Paso County, El Paso, Texas, had been figuring on a method of placing these culverts under roads without cutting the pavement. Not long ago the matter was taken up with C. A. Campbell, a well-drilling contractor of El Paso, who, with available second-hand equipment, worked out the plan and rig used for the illustrated installation. The plan was a success. The pipe was installed and the pavement was not cut.

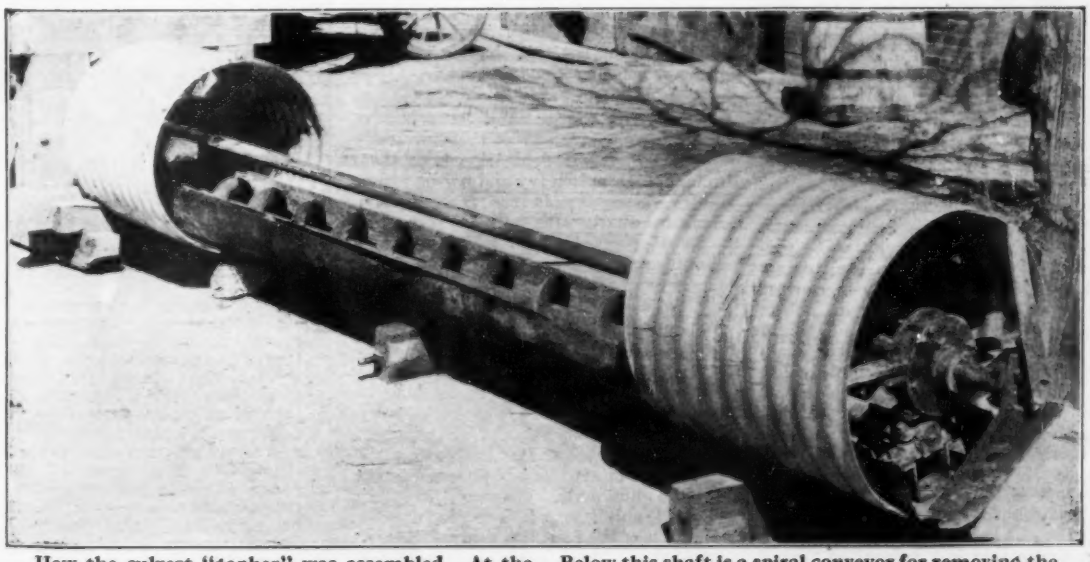
The plan was to use a motor with the drive shaft extended to the length of pipe to be installed, with cutting blades attached to one end. This shaft was held in place in the center of the pipe by blocking at four different places. A trench was then dug outside of and at right angles to the pavement, sufficiently wide, deep and long to place the engine and the entire length of pipe, all assembled on a skid track in the bottom of this trench. By means of blocking and a small three-ton jack, the pipe was then pushed up against the embankment to be cut through. As the cutting took place ahead of the pipe, blocking and jacking of the pipe into place continued until the entire pipe was put through, pressure being put on the cutting blades at all times. To take care of the dirt coming back through the pipe, another shaft, driven from the main shaft, was run through the pipe, with a nine-inch cotton-seed conveyor riding in a smooth sixteen-gage sheet-metal form. This delivered the dirt to the rear end of the pipe where it was easily shoveled out of the way.



Through! The end of the pipe was not even bent or damaged in the least. Traffic was not delayed, the road was not taken up, and gasoline did the hardest part of the work

Experience has already indicated that a few changes should be made in the rig. First, the main shaft should not be driven direct with the drive shaft of the motor but should be geared down. Second, the shaft should carry a second set of cutting projections heavier than the blades and of a smaller cutting diameter, placed in front of these blades, for roughing out the opening. Third, a flywheel should be used on the shaft. Other improvements than these undoubtedly will be made, but these three were most forcibly brought to attention during the first trial.

On this one installation, setting up the rig and placing the pipe (which was an armco iron pipe, 24 inches in diameter by 26 feet long) took five days and probably cost as much as the old method,



How the culvert "gopher" was assembled. At the right are the cutting blades, driven by a shaft. Below this shaft is a spiral conveyor for removing the excavated earth as the "bit" of the device advances

Science Service

Poison ivy and its west-coast relative, poison oak, are very much alike in general appearance. They grow either as climbing vines or as erect, slender-stemmed shrubs from underground rootstocks, and are distinguished by their glossy, green, three-part leaves, unlike those of any other common plant

but it is believed that after a few installations, pipe of this size and length can be placed in not over three days with a crew of men not to exceed five or six.

Poison Ivy Conquered by Simple Chemicals

"POISON IVY, the bane of the vacationist's existence, is with us again. Remedies by the hundreds are recommended by doctors, by druggists, by old-fashioned housewives. Some of them work; some of them just serve to keep the patient in as cheerful a frame of mind as possible until the afflicted place gets well by itself," says Dr. Frank Thone, of *Science Service*. "The handling of ivy poisoning, and of its kindred ailments, oak and sumac poisoning, is still in a more or less chaotic condition.

"Scientific order, however, is being brought out of it by the efforts of botanists, chemists and physicians," continues Dr. Thone, "and now there are a few standard remedies, and what is even better, standard preventives, that anybody can have his corner druggist mix up in few minutes. There is nothing patent or proprietary about them; they are all old familiar chemicals, and they do not cost much.

"The best remedy is axiomatically one that destroys the cause of the ailment, and it is for this reason that Dr. James F. Couch, of the United States Department of Agriculture, expert on poisonous plants, recommends the use of a solution of permanganate of potash to stop the itching, blistering irritation that follows contact with poison ivy, poison oak or poison sumac. Five percent of the compound in water is all the prescription your druggist will need. Bathe the afflicted skin freely with this solution, swabbing it on with a bit of cotton or soft cloth, and the poison will be oxidized and destroyed. This treatment leaves a brown stain on the skin, which can easily be removed in any one of a number of ways. A 1 percent solution of oxalic acid, Dr. Couch says, is the quickest means.

"But oxalic acid is a poison, so that if you are afraid of children getting hold of it, you may use instead a 1 percent solution of sodium bisulphite, or even just plain soap and water, though the latter is a bit slow in taking off the stain. If the skin has been very much broken by scratching or otherwise and is raw, the oxalic acid will cause a temporary stinging and soap and water is preferable for removing stains from such sensitive surfaces. If the skin is very tender, the solution of potassium permanganate may be diluted with water before using.

"The permanganate treatment is recommended only as a remedy for poisoning that has already taken place. Persons who know that they are likely to be poisoned may prevent the plants from harming them with a wash devised by Dr. James B. McNair, of the Field Museum, Chicago. This consists of a 5 percent solution of ferric chloride in a fifty-fifty mixture of water and glycerin. This is to be washed on all exposed parts of the skin and allowed to dry there, before going where the dangerous weeds grow. The iron in the chemical combines with the poisonous principle of the ivy and changes it into a harmless, non-poisonous compound.

"This 'iron cure' has been thoroughly tested by professors and students of the botany department at the University of Chicago. Their field trips take them through much poison ivy and poison sumac country, especially in the famous Lake Michigan dunes. Before they began to use Dr. McNair's treatment, ivy and sumac poisonings were taken as a part of the natural hazards of a scientific course, but now they are rare occurrences.

"Dr. McNair disclaims credit for the first discovery that a solution of an iron salt will help in the treatment of ivy poisoning. Indeed, it would be hard to think of something to put on an ivy-blistered skin that has not already been tried, for the more or less authentic remedies he lists in his monograph run literally into the hundreds. Common copperas, which is sulphate of iron, is used in some parts of the South, and iron salts were suggested by physicians many years ago.

"But Dr. McNair was the first man who extracted the poisonous principle of the plants in a concentrated form, anaylzed it chemically, and found that when mixed with an iron solution it became insoluble and was no longer poisonous. His claim to recognition therefore rests on the fact that he first firmly established the 'iron treatment' of ivy poisoning on a solidly scientific basis, especially as regards its value as a preventive.

"Poison ivy is more of a terror than it has cause to be, for all scientists who have studied the subject agree that many persons, perhaps even a majority, are more or less immune to it. No one, says Dr. Couch, is absolutely ivy-proof; he can raise blisters with the squeezed-out sap of the plant on the skin of any one hardy (or foolish) enough to volunteer for such an experiment. But many of these same persons can walk around in it all day, or pull it up by the handsful, with no ill effect whatever.

"But this should not encourage these lucky ones to be too reckless. Immunity to poison ivy does not always stand at the same level, but apparently suffers occasional let-downs, and if one happens to get poisoned during one of these low spells he never recovers his lost immunity, but remains susceptible for the rest of his life.

"Dr. Couch states also that ivy poisoning is really a double effect. The blistering and itching are caused, he says, by the substance which Dr. McNair isolated and named 'lobinol,' and the swelling and reddening of the afflicted parts, together with the general 'all-gone' sick sensation that so seriously affects many poison-ivy patients, are what is known as an 'allergic' reaction, more or less analogous to most kinds of hay fever, and are probably due to some other poisonous substance not yet identified. Persons who are susceptible to the blistering effects of the ivy are often quite immune to this allergic reaction.

Science Service

Poison sumac looks much like common sumac, but it always grows in or near acid-water bogs. Its fruits are smooth, round, white berries that hang in drooping loose bunches, while the ornamental sumac's fruits are small and rough, dark brown in color, and stand erect in close pyramidal clusters. The bark of poison sumac is pallid gray, while that of the common sumac is brownish, or very hairy and sooty-black. Poison sumac is reported to be worse in its effects than poison ivy, but dangerous to fewer people

For this part of the poisoning effects the various chemical treatments recommended for the blisters and itching are of no use; all the patient can do is go to bed and keep quiet until he feels better.

"But after all has been said about remedies and preventives and the fortunate immunity of many persons, the best prescription for poison ivy and its relatives is to know them when you see them, and let them severely alone."

Another Transmutation Experiment Fails

THE dream of the ancient alchemists, thought to have been realized by the transmutation of hydrogen into helium by Drs. Fritz Paneth and Peters, noted German chemists, has had to go back to the status of a dream once more, according to a report in the German scientific journal *Die Umschau.*

Prof. Paneth has himself retracted the claim that he changed one element into another, because of the discovery of two hitherto unsuspected sources of error in his apparatus. Ultra-minute quantities of helium were held absorbed in a mass of asbestos, used in the apparatus, and a still smaller amount was dissolved in the glass tubing. These hidden traces of gas came out when heated, and infinitesimal in amount though they were, they registered their presence and thus led to the mistaken impression that helium had come into existence where none had been before.

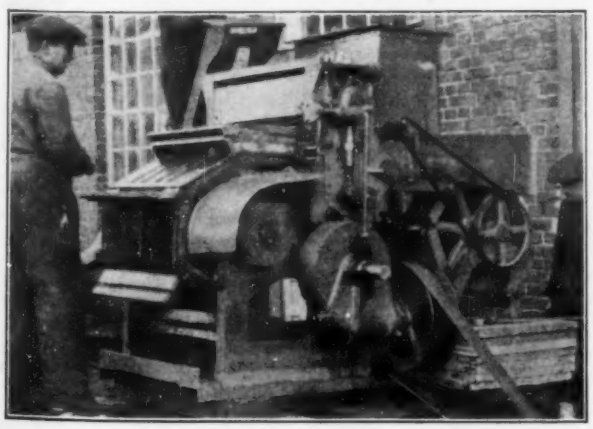
Prof. Paneth recently spent several months at Cornell University as nonresident lecturer in chemistry and much of his time was spent in research upon the problem of transmutation. His experiments were also repeated in the chemical laboratory at Princeton University with his cooperation. The Princeton chemists are understood to have been unable to bring about the transmutation of hydrogen into helium.

—*Science Service.*

"Ice Concrete," a Remarkable New Building Material

"ICE CONCRETE" is the name of a new, porous and light building material recently invented in Finland. This new substance is made of cement and sand, like any other concrete, but it differs greatly from ordinary concrete in that it has been made extremely porous by mixing it with crushed ice and snow. Then the moisture is evaporated through heating. By this process the block or the brick is honeycombed evenly by tiny pores. No additional water in composition is needed since the water required is formed through the melting of the ice or snow.

The degree of porousness of this concrete can be accurately determined in advance by the quantity of ice or snow used. Consequently, the weight of the material is in direct relation to the number and the size of the pores. It is possible to use as much as from 50 to 80 percent of ice or snow in the mixture, thus producing millions of minute pores throughout the material. In Finland, Sweden and Denmark numerous buildings have been erected, using ice concrete.



A machine for mixing and casting porous "ice concrete" blocks. The process consists of mixing concrete with crushed ice or snow, casting the blocks, and removing the moisture by heating. This method produces blocks which are porous to a degree depending on the amount of ice or snow entering into the original mixture

P and A

Starting out for the scene of a motor accident. These two officers of the only automobile homicide squad in the United States are equipped for obtaining photographic and other evidence. A camera and its accessories, and a portable typewriter permit taking evidence on the spot of the accident

Only Auto Homicide Squad in the United States

WITH the increasing hazards of everyday motoring, Traffic Commissioner Edward J. Donahue of the Cleveland police department has organized a special Homicide Squad in hopes of curbing deaths which have been caused by careless drivers. The squad, which is the only one of its kind in the country, is supplied with complete photographic equipment, including a darkroom for developing pictures taken immediately after accidents, two offices and complete files for keeping records.

There is always a sergeant and one patrolman on duty awaiting the call that a serious accident has occurred. Both men are trained in the use of cameras and draughting materials for making sketches.

When an accident has occurred, these officers start out in their own motor car, one taking a camera and the other a portable typewriter. Arriving on the scene, they take pictures from every angle, a complete report is typed on the spot and all available witnesses, including the drivers and occupants of the cars involved, are brought to the office of the squad.

Forty-three drivers have already been convicted for manslaughter. Convictions for careless driving and failure to stop after accidents run into hundreds.

Police Prove Long on Brain Power

ONE California town, at least, has a police force with intelligence averaging higher than that of college freshmen and army officers. This announcement, following on the heels of statements that policemen in American cities are short on brain power, is the result of an investigation made at Palo Alto, California, by Maud A. Merrill, of the psychology department of Stanford University.

The investigation was designed to find out whether men of comparatively high intelligence and ability make good policemen and are satisfied with the work, Miss Merrill reports in the *Journal of Personnel Research.*

For two years, each applicant for the Palo Alto force has been given the Alpha intelligence test used to grade the mentality of United States soldiers during the war. Out of 113 applicants, 30 were chosen on the basis of their intelligence, together with the impression they made on the examiners.

"The average Alpha intelligence score of men who have remained on the Palo Alto police force for two years is 143.5, a score higher than the average for army officers and higher than that reported as the freshmen average at many colleges," says Miss Merrill.

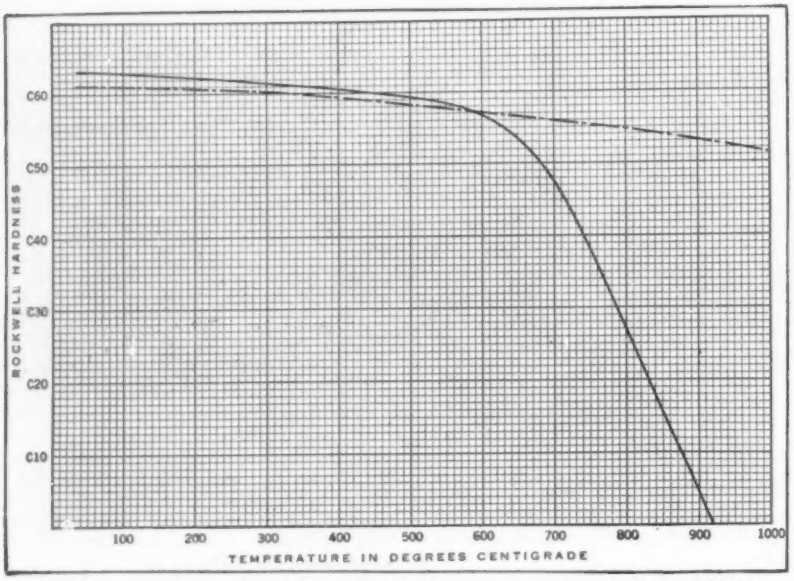
"The median score of men who have been discharged for inefficiency or for conduct unbecoming an officer is 137. Men who left voluntarily for better jobs have a median score of 171.5. One of these men left the police force to go into grand opera."

The median Alpha score made by white drafted soldiers was about 60.

—*Science Service.*

Extremely Hard Alloy Defies Wear

HOW the revolving cutter of a hydraulic or suction dredge was protected with an extremely hard alloy called "stellite," which resists wear to a



In this curve, the red hardness of stellite is compared with that of high-speed steel. Dotted curve represents stellite; solid line represents the steel

remarkable degree, is explained in a recent issue of *Oxy-Acetylene Tips* (New York). These cutters work deep in the mud, clay, sand and gravel of harbors and are ordinarily subject to extreme wear, necessitating frequent replacement. But when coated with stellite, their life is multiplied several times. Stellite is an alloy of chromium, cobalt and tungsten. It retains its hardness up to a temperature of 1830 degrees, Fahrenheit, long after steel tools have softened, and for this reason it is frequently used for machine tools. Says *Oxy-Acetylene Tips:*

"As the cutter loosens the dirt, it is drawn into a suction pipe by a powerful centrifugal pump, and then forced out through the discharge pipe to the point of disposal. Obviously the cutter blades wear very rapidly, replacement is an ever-present problem, increasing in seriousness as the dredges are used in more remote localities.

"Recently a dredge was sent to a South American harbor. It was known that the digging was such that the life of the rotary cutter would be only about six weeks. As this is a steel casting about four feet in diameter and four feet long, weighing about 3500 pounds and worth 800 dollars f. o. b. the American foundry, the question of a duplicate for replacement immediately arose.

"Each of the six cutter blades is about 12 inches wide, the cutting edge being three eighths of an inch thick, increasing to about one inch at the rear end. Use wears the blades down until four or five inches wide, when replacement is necessary.

"In view of the expense of the cutter, and the possible delays in delivery, it was proposed to protect the cutting edges with stellite.

"For this purpose a band of stellite about four inches wide and 25 inches long was to be applied along the inside and outside faces of the cutting edge of each blade. (This stelliting process is based on the fact that stellite melts at a lower temperature than steel and adheres very tenaciously when properly applied. It is used in the form of welding rod and an oxy-acetylene blowpipe furnishes the heat necessary.

"As will be evident from the accompanying illustrations, welding was complicated to a certain extent by the curvature of the blades, which made it necessary to change the position of the cutter at brief intervals. The stellite coating was three-sixteenths to one-quarter of an inch thick, 150 pounds of the alloy being required for the six blades. The casting was very rough and had been painted, all of which tended to impede the operation. It therefore took about 105 hours to complete the work.

"This protecting layer brought the total cost of the cutter up to 1700 dollars, a little more than twice the cost of the unprotected casting."

Further interesting facts about stellite appear in a booklet published in Kokomo, Indiana. While the fact that stellite retains its hardness up to 1830 degrees, Fahrenheit, is a great advantage—in fact, one of the principle advantages of the alloy—this advantage actually militates against the material when it comes to working it, for the hardest grade of stellite can neither be forged nor machined; grinding is the only method of modifying the shape of the casting. However, a softer variety of the alloy is made, which can be rolled, forged and stamped at the temperature named; this is comparable to the harder variety in resistance to abrasion and corrosion but is inferior in hardness.

Stellite is deposited on metal by the process of fusion welding, as shown in the accompanying illustrations, and the process is best accomplished by the oxy-acetylene flame. The relative resistance of stellite, as compared with steel, varies from four to nine times. Most acids and reagents do not attack it. Among its varied uses are for well drill-bits, dentists's instruments, dies, knives, and machine tools. It also has been considered as one of a number of candidates for the material from which the mirror of the projected 12,000,000 dollar, 25-foot reflecting telescope might be made. Its reflecting power is 68 to 83 percent; that of silver, 68 to 95 percent.

How the alloy stellite was fused to the steel knives of the cutter of a hydraulic dredge, with a torch

The knives of a large dredge cutter, protected against rapid abrasion by a deposit of stellite alloy

INDUSTRIES FROM ATOMS

A Department Devoted to the Advancements Made in Industrial and Experimental Chemistry

CONDUCTED BY D. H. KILLEFFER

Boll Weevil Control

THE ever pressing problem of protecting growing cotton from the ravages of the boll weevil has been given serious study by members of the Chemical Warfare Service at Edgewood Arsenal, with the result that much light of great probable value has been shed upon it. Investigations involving more than 1000 possible poisons and poisonous mixtures and their action on more than 150,000 boll weevils are reported in a recent number of *Industrial and Engineering Chemistry* by H. W. Walker and J. E. Mills. While this is merely a progress report, it shows that 22 materials possess a toxicity for the boll weevil greater than that of calcium arsenate, now considered the standard, and cause less injury to the plant itself.

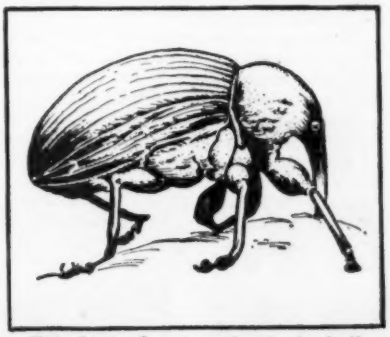
In discussing this investigation, an editorial in the same issue of *Industrial and Engineering Chemistry* states:

"One interesting result of investigations made by the Chemical Warfare Service looking to the better control of the cotton boll weevil has been the development of a process which promises calcium arsenate in acceptable physical form at lower costs. The extent to which the cotton farmer can employ calcium arsenate is determined by the price of cotton and its relation to the price of this chemical compound. While both prices fluctuate between wide limits, it is obvious that a uniformly low-priced arsenate would encourage its more frequent and extensive use, thereby affording a more complete control of the boll weevil and consequent lower production costs for the cotton farmer. The perfection of the process is another indication of the peacetime utility of the Service."

The investigations included not only materials which might be poisonous to the weevils but also studies of odors and flavors that might attract or repel them and of various irritants that might drive them away. In stating their conclusion, these investigators summarize their findings as follows:

"1—Commercial sodium fluosilicate is more toxic to the boll weevil than commercial calcium arsenate on a volume basis, but on account of the greater apparent density of the fluosilicates, it requires from two to four pounds of them to cover effectively the same area that one pound of commercial calcium arsenate will cover. These commercial fluosilicates show some injury to the cotton plant. So-called "light" and "extra light" commercial materials containing less sodium fluosilicate are still too dense from the standpoint of covering power, and their effectiveness is decreased with the lowering of the Na_2SiF_6 content. Also, the plant injury is decreased. When the Na_2SiF_6 content is reduced much below 80 percent, the material is not so effective as calcium arsenate.

"2—A special fluosilicate made at



This large drawing shows the boll weevil, an insect which the science of chemistry is combating successfully by the methods described

Edgewood Arsenal, containing about 80 percent Na_2SiF_6 and 20 percent SiO_2, is at least as effective on a pound per pound basis as calcium arsenate, and the plant injury caused by it is of low economic importance.

"3—Barium fluosilicate, made in the same way as the sodium fluosilicate, containing about 90 percent $BaSiF_6$ and 10 percent SiO_2, is about as effective on a pound per pound basis as calcium arsenate and causes no appreciable plant injury. The toxicity of the barium fluosilicates in general is somewhat less than that of the sodium fluosilicates.

"4—When the dust is applied to the plants five days before the weevils are introduced, both the sodium and barium fluosilicates cause at least as great weevil mortality as freshly dusted calcium arsenate. Calcium arsenate applied five days prior to the introduction of weevils in the cage causes appreciably lower mortality than freshly dusted calcium arsenate. In these tests the cages were covered to prevent rain from washing the dust off the plants.

"5—Specially prepared calcium arsenate containing only 24 percent arsenic as As_2O_5, the arsenic being contained mainly in the coating of each particle, is equally as effective as commercial calcium arsenate and was non-toxic to the plant in these tests. Calcium arsenate similarly prepared, containing only 10 percent As_2O_5, was less effective than commercial calcium arsenate.

"6—Calcium arsenate may be prepared to contain any desired percentage of arsenic as As_2O_5 by heating the requisite amount of As_2O_3 with precipitated chalk in the presence of air at a temperature of about 650 degrees, Centigrade, for one hour or less.

"7—Barium fluoride and cryolite are at best only slightly less effective than calcium arsenate on a volume for volume basis and cause no appreciable plant injury. They require an increased poundage per acre over calcium arsenate, however, and no economical means of adapting their physical properties to overcome this has yet been devised.

"8—While small percentages of As_2O_3 adsorbed on coal dust showed definite weevil toxicity and practically no plant injury, they were not so effective as calcium arsenate. When these percentages were increased, they caused definite plant injury without raising the weevil toxicity to a point equal to that of calcium arsenate. Four percent of arsenic trioxide on coal dust killed the plant. Arsenic trioxide is definitely more toxic to both the plant and the weevil then arsenic pentoxide.

"9—Very insoluble organic arsenicals of known high general toxicity, such as diphenylamine chloroarsine, diphenylamine arsenious oxide, diphenyl arsenious oxide, et cetera, were at best only slightly toxic to the boll weevil, owing probably to their low solubility.

"10—Preliminary tests indicate that the fluosilicates in molasses mixtures are at least as toxic to the boll weevil as calcium arsenate in molasses mixtures. It is further indicated in tumbler tests that molasses mixtures of calcium arsenate are about as toxic to the weevil as calcium arsenate dust. There are some indications that a calcium arsenate-honey mixture is superior to a calcium arsenate-molasses mixture containing the same amount of calcium arsenate.

"11—Unfavorable weather and crop conditions made it impossible to make trustworthy comparisons of the relative effectiveness of the fluosilicates, the special calcium arsenate, and commercial calcium arsenate from the one-acre plot tests made to date. All these materials showed definite weevil control and there was no plant injury apparent on field cotton in any case. It is hoped to establish the relative effectiveness of these materials during the present year.

"12—There is little hope of poisoning the boll weevil in the field by the use of volatile gases.

"13—The following are various estimates pertaining to the weevil:

Average weight of a boll weevil (does not include undersized weevils) 15.0 milligrams.

Amount of air breathed by a boll weevil per hour, 0.33 cubic centimeters.

Minimum arsenic required to kill a boll weevil, 0.00013 milligrams*.

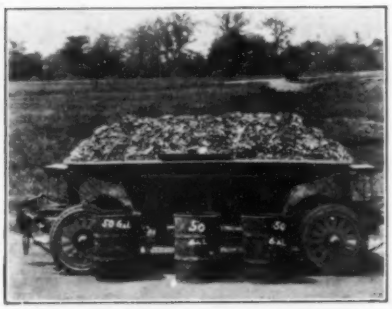
Average arsenic content found in weevils killed with calcium arsenate, 0.002 milligrams.

Amount of water a weevil drinks per day, 0.02 cubic centimeters.

*Possibly too high.

"14—No substances were found which definitely attracted or repelled the boll weevil. No substances were found which irritated the weevil sufficiently to make it fly.

"15—In carrying out the directions of the Association of Southern Agricultural Workers and the Department of Agriculture for boll weevil control, the following suggestion is made: When the initial weevil infestation is below twenty weevils per acre or when it is, or has been, reduced to local infestation, the fight should be continued against the individual weevils both by local poisoning and by picking up the fallen punctured squares locally, as necessary, to insure the most complete control possible. Advanced cotton and badly infested cotton should receive special attention in order to prevent multiplication of the weevils in these local spots and later infestation of the entire crop. Success in the fight against overwintered weevils will give complete security against any large amount of weevil damage."



The three drums show the amount of water drained from a normal trailer-load of garbage. The removal of this weight greatly facilitates transportation and allows more material to be carried in one of the trailers that are used

Profitable Garbage Disposal

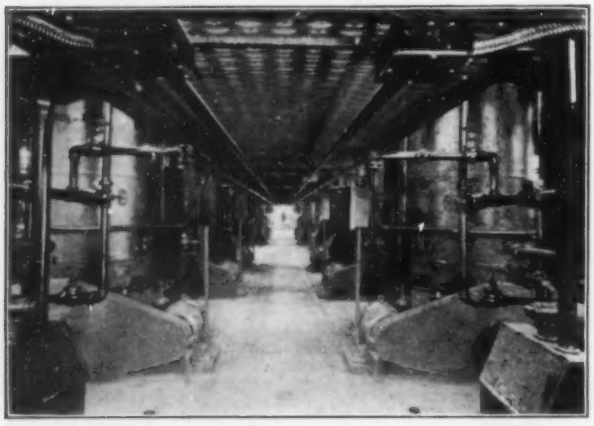
THE municipal garbage-disposal plant at Indianapolis, treating 32,000 tons of garbage annually showed a profit of 29,000 dollars on the operation during 1926, according to Harrison E. Howe in a recent article in *Industrial and Engineering Chemistry*. Mr. Howe begins his discussion by asking this question: "Is the garbage of an American city a material so valueless as to merit only complete destruction by fire, or is it a waste worthy to be classed as a raw material capable of yielding a profit when treated in accordance with most modern procedure?" He finally makes this statement: "It seems to have been demonstrated that when properly processed, American city garbage is a material well worth working for its values and that this step in conservation can be widely recommended."

The crux in the matter of profit seems to have been the use of the newly developed McCullough-Nolen dewatering device in collecting garbage and improvements in its treatment. "This," according to Mr. Howe, "consists in the use of metal trailers for the collection of the city's garbage, these trailers being provided with a false bottom which accomplishes dewatering to a remarkable degree. There is simply a perforated plate over the entire bottom of the trailer, and as the garbage is dumped from each household container and the trailer travels along the alley route to the next house, the water is shaken out and drains into the receiving compartment in the bottom of the trailer. To empty the water compartment, the garbage collector opens a standard two-inch molasses cock, and drains the trailer into any convenient sewer manhole. In the course of collection, the compartment may be drained three or four times and as much as 200 gallons of free water may thus be eliminated without expense and to considerable advantage.

"The advantages include the elimination of some of the hazards of garbage collection, less odor and fly nuisance, and particularly the complaints of the residents as to the spillage of garbage along alleyways and streets. The load is comparatively dry and when covered with a tarpaulin is no more objectionable than any other truck or trailer passing through the streets. By eliminating this water, larger loads can be hauled and the capacity of the reduction plant is increased, the garbage is received at the plant in better condition for reduction, a large part of the odors about the reduction plant is prevented and the dewatered garbage gives better products, which in turn means a larger profit on operation. The small amount of grease lost with the water is of no moment in the face of these benefits.

"The trailers previously described are delivered at a receiving station which has a capacity of 400 tons of green garbage. The floor of this station is so designed as to permit the dewatering of green garbage to continue before being conveyed to the digesters. A special power scraper, making unnecessary the twelve men otherwise required to shovel the green garbage to the conveyor, has been installed and serves to move the mass to a floor conveyor."

The garbage thus collected and dewatered is passed over a magnetic pulley to remove iron and is then conveyed to rendering tanks where it is steamed to remove grease. The recovered grease has a ready market. The residue in the digestors is dried in a vacuum before its removal. A unique arrangement removes foreign matter from the prepared tankage and turns out a product containing less than 0.1 of 1 percent of glass and china and no free metals.



A row of digester tanks in a garbage-disposal plant. In the foreground are motors which drive agitators. Note pipes for carrying the grease-bearing liquids

Bits of china, metal and the like, often found in garbage, must be removed at the disposal plant. The illustrated machines, called separators, accomplish this work

Learning To Use Our Wings

This Department Will Keep Our Readers Informed of the Latest Facts About Airplanes and Airships

CONDUCTED BY ALEXANDER KLEMIN
In charge, Daniel Guggenheim School of Aeronautics, New York University

Lindbergh's Transatlantic Flight

COLONEL CHARLES A. LINDBERGH left New York on Friday morning, May 21, at 7.52 A.M. and reached Paris on Saturday, May 22, at 5.24 P.M. Eastern Standard Time, after flying for approximately 33½ hours and covering about 3650 miles. The average speed of the flight was about 109 miles per hour, somewhat faster than he had estimated. There is no doubt that following winds favored the flight to some extent.

Barring some fog, overcast conditions and perhaps slight precipitation in the vicinity of the icebergs, the experts had predicted fair weather in the mid-Atlantic, and only slight rain in a region of low pressure near Paris. Head winds slowed down the plane in the early stages of the flight, but this was more than compensated for later on. On the whole the experts' predictions worked out well. The fog proved no insurmountable obstacle: "I expected trouble over Newfoundland," said Colonel Lindbergh, "because I had been warned that the situation was unfavorable. But I got over that hazard with no trouble whatsoever. However it was not easy going. I had sleet and snow for over 1000 miles. Sometimes it was too high to fly over and sometimes too low to fly under, so I just had to go through as I could. I flew as low as 10 feet in some places and as high as 10,000 feet in others." At the end of the flight enough fuel remained for another 500 miles.

Lack of sleep did not bother the extraordinary aviator. A couple of sandwiches and a little water were rations enough; he counted on hunger to keep him awake.

He struck the coast of Ireland almost exactly at the plotted point, was escorted over the English Channel by a squadron of British planes, and had no difficulty in locating Le Bourget, guided by forty French flares.

The tremendous ovation awarded to the unconcerned young man, and the world-wide enthusiasm aroused, will remain forever in aeronautical history.

Before Lindbergh's wonderful flight, expert opinion had been inclined to favor the chances of Byrd's *America*. Byrd had a three-engined plane and therefore greater power-plant reliability; two pilots, relieving one another at need; better vision and accommodation in the pilot's cockpit; a skilled navigator and all the instruments necessary for sighting the sun and checking position; a better supply of food and water; and above all human companionship. His expedition was also better prepared for accident with rafts, radio, signal flares, and a carefully rehearsed plan of action in case of accident.

If the *America* had succeeded, its triumph would have been perhaps a more convincing precursor of the commercial conquest of the Atlantic. However, Lindbergh's success proved that personal skill and courage could offset somewhat greater engineering facilities. It must not be thought, however, that the gallant aviator was not fully prepared. He had worked long and earnestly, and to great courage was joined excellent equipment and much forethought.

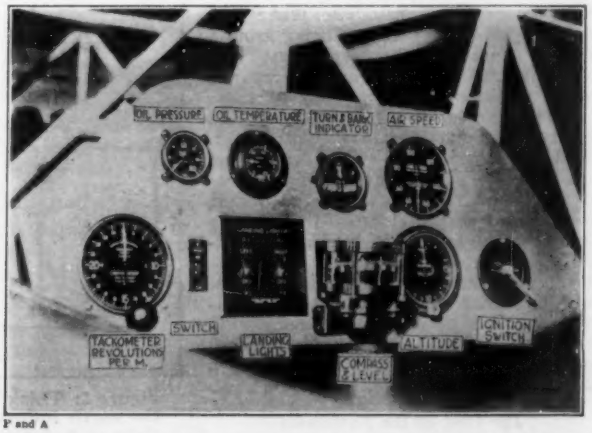
The Engine Used

He had in the air-cooled Wright J engine or "Whirlwind," as it is picturesquely termed, a well-tried mechanism of remarkable lightness, efficiency and endurance. The design of this engine was begun on February 28, 1920. It has passed through a long development in successive models; the J-1, J-2, J-3, and J-4. The J-5 successfully met the rigid endurance tests of 50 hours at full throttle—far more severe than the requirements of actual flying. In one extraordinary 50-hour test, conducted in the hottest part of the summer, the average temperature was 150 degrees, Fahrenheit, at the point of entrance to the carburetor, and the power averaged 295 horsepower at 2150 revolutions per minute, although the normal rating of the engine was only 200 horsepower at 1800 revolutions, and the weight dry was only 508 pounds. Moreover, the Wright Aeronautical Corporation had the advantage of service tests in many Army and Navy planes, and of almost universal employment of their engines in commercial planes such as the Fokker, Ford, Keystone, Laird and Sikorsky. Among other records, the spectacular endurance test of April 12-14, when a Bellanca plane stayed aloft for 51 hours, 11 minutes and 25 seconds, with a stock engine which had already had some 179 hours of flight, was but a confirmation of the engine's reliablility. Its fuel economy was moreover equal to that of the very best engines ever built. On the flight to Paris, the fuel consumption averaged less than 13 gallons per hour or over eight and one-half miles to the gallon. Even granting the following winds which favored the flight, this is a remarkable record of efficiency.

The actual fuel statistics of the transatlantic flight as given in a cable by Lindbergh were as follows: "Consumption checked only to-day. Fuel, 432 gallons, oil 11.8 gallons. Average revolutions per minute of the propeller 1600. Throttled down after take-off. Open to 1800 when climbing over sleet. 'Whirlwind' engine functioned perfectly during entire flight from San Diego to Paris, and was in as good condition at Paris as at San Diego." The engine was therefore close to its rated revolutions per minute throughout the flight.

Wide World

Figure 1: Colonel Charles A. Lindbergh and the *Spirit of St. Louis*, which he flew from New York to Paris



P and A

Figure 2: The instruments which guided Lindbergh safely to Paris. Their various uses are indicated above

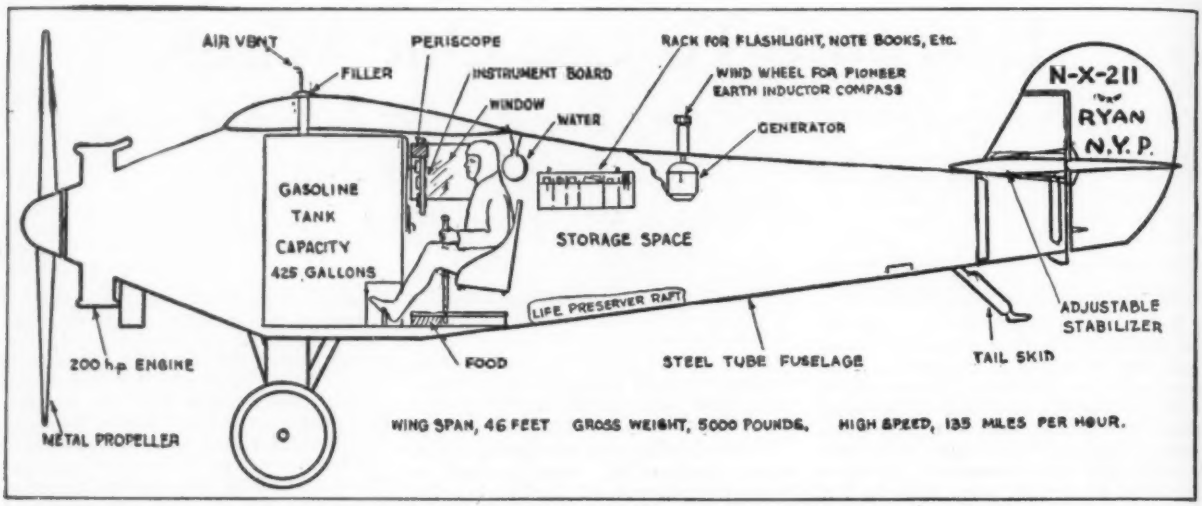


Figure 3: A cross-section view of the *Spirit of St. Louis*, showing the placement of the more important parts of the equipment of the monoplane. The position of the gasoline tank gives safety in case of a crash

The Ryan Monoplane

The *Spirit of St. Louis*, see Figure 1, was a stock monoplane model built by the Ryan Airlines of San Diego. The only alterations made were in the addition of ten feet to the wing span, increasing it to 46 feet; in fairing up the ship in every possible way, such as bringing the strut ends smoothly into the wings; in placing the huge gasoline tank of 425 gallons capacity in lieu of the passenger compartment, and in totally enclosing the pilot's cockpit. The enclosing of the cockpit was intended to improve the speed and fuel economy, since the slightest break in the fuselage means additional air resistance. That it achieved these ends is shown by maximum speed of the craft, estimated at 135 miles an hour, and by the fact that at the end of the flight, fuel for 500 miles remained.

Speed and economy were purchased indeed at the expense of diminished vision. As seen from our diagram in Figure 3, Lindbergh could see only through a small aperture in front which he called his "periscope," or through the window at his left.

The plane fully loaded for the trip weighed 5200 pounds. This meant a loading of 26 pounds per horse-power and with a wing area of about 320 square feet, a loading per square foot of wing of 16.2 pounds. The plane had difficulty in getting off, touching ground twice before the final get-away, and showing the slowest possible rate of climb at the start.

The get-away probably offered the most hazardous moment of the flight. Had the sacrifice of vision not been made to get the last degree of aerodynamic refinement, Lindbergh might have failed to get clear. His boldness was fully justified. It is also an attribute to the sterling qualities of the Ryan monoplane that the huge overload was sustained without structural modification other than the increase in wing span, and that the gross weight of 5200 pounds is the largest ever sustained by a 200 horsepower engine.

The Cost of the Equipment

The actual cost of the Ryan monoplane was 6000 dollars. It was built and ready to fly in 60 days. The instruments and the engine cost 6900 dollars, bringing the total equipment cost to 13,000 dollars. This can hardly be considered expensive for the result achieved.

Lindbergh's Plan of Flight

To people who knew how carefully Commander Richard E. Byrd had planned to navigate, taking sextant observations every half hour, and how difficult is the problem of piloting a plane on a straight course over water, where there is nothing on which to sight, it appeared that Lindbergh was taking a tremendous chance in depending upon dead reckoning alone. His spectacular flight at night, from San Diego to St. Louis, did much to dispel these doubts. At the end of the 1600 mile flight, he had found himself only 15 miles off St. Louis, having successfully allowed for drift, magnetic variations and the special deviation of his compass.

Lindbergh set out with the fullest confidence in his ability to navigate the Atlantic. We must quote his own words as to his plans: "People forget that I will be able to check my course by the map all the way from New York to Newfoundland. Even at night I could do that, for unless the night is very dark it is possible to distinguish water from land. On a moonlit night it is very easy. The most difficult hours of the flight, the first 14, will be over land most of the way, and if I can get a good sight of the coast of Newfoundland as I leave it, I should be able to get my bearings with some degree of accuracy. The worst compass variations also are on the way to Newfoundland. From there on over the ocean, the variations are not more than two to four degrees. That is not bad. I can easily allow for them and even granting that I make the worst possible error, an error of four degrees, it would only put me 100 miles off my course. The question of drift is a different thing. It is very hard to tell just what one's drift is over water, for there does not seem to be any motion at all unless it is very rough. But I will carry smoke bombs and with the drift indicator it should be possible to get some idea of the direction of the wind and the effect it is having on the plane."

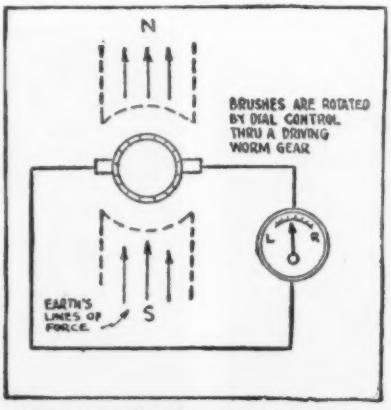


Figure 4: This diagram shows how the earth inductor compass functions. A description is given in the text on the opposite page

Lindbergh would not have been able to use a sextant even if he had known how, as his cockpit was entirely enclosed, and he could not have obtained sights unless the sun was at his left, where he could stick his head out of the window. As events prove, his confidence in his ability to navigate by dead reckoning, (that is without sighting the sun or stars), was entirely justified.

It should also be pointed out that his instruments were adequate in every respect except as regards inclusion of the sextant, and that Lindbergh had not scorned to get the best technical advice in his detailed plan of navigation.

The Course as Plotted and Flown

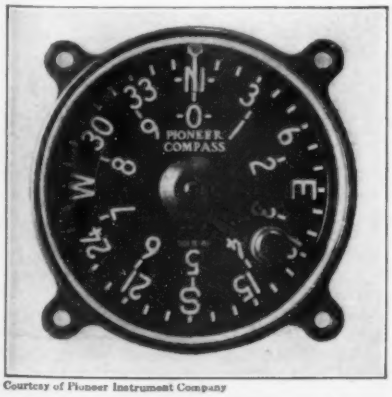
In particular he received assistance in establishing his course from Brice Goldsborough of the Pioneer Instrument Company. On the Hydrographic Office Chart of the North Atlantic, a great circle track was plotted, on which lay the shortest distance between New York and Paris. It may be of interest to note that great circle flying is not the usual method of navigation over land. In flying over land, the distances between points are very

much shorter and pure triangulation can be resorted to without appreciably lengthening the course.

But a statement by the National Geographic Society will clearly show why great circle flying was necessary in this flight. "Lindbergh was not going out of his way. He was making a bee-line for Paris. To non-seafaring folk, it is rather a surprise to note that the shortest course from New York to Liverpool lies across New England and Canada, west of Nova Scotia, and through inland Newfoundland. Ships cannot sail overland but they do veer as far north as the double obstacle of land and icebergs will permit. The reason for this, technically stated, is that in the higher latitudes the shortest distance between two points, because of the earth's curvature, is not on the east and west parallel, but on the arc of a circle which would divide the earth in two equal parts and pass through the points in question (a great circle).

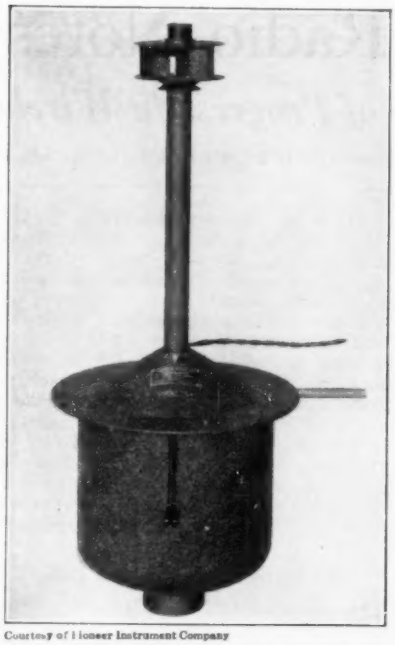
"A far simpler way to prove this is to take a piece of string and apply it to a globe. That piece of string will reveal more amazing facts about oceanic commerce than volumes of trade statistics. It will show why Norfolk, Virginia is a normal coaling port for all Europe-bound vessels out of our Gulf ports. Looking at a flat map of the world, it would seem as if Lindbergh's shortest course would have been to fly out in an easterly direction from New York and past the vicinity of the Azores. Apply your string to a globe and you will find that the flying distance from New York to Paris, via Azores would be 4107 statute miles, whereas a course outlined by a string stretched tautly on the globe from New York to Paris, across New England, Canada and Newfoundland, and south of Ireland, the way Lindbergh flew, would be 3633 miles. Lindbergh flew that way to save 474 miles."

On the ideal great circle course, the actual distance between Mineola, New York, latitude 40° 44′ 18″ north, longitude 2° 20′ west, and Paris, latitude 48° 50′ north, longitude 2° 20′ east, was 3610.1 statute miles. The actual course which Goldsborough advocated for Lindbergh was slightly different. Considerations of steamship lines led to a course which was south of the great circle at the start and somewhat north of the great circle after passing mid-Atlantic. For Lindbergh's convenience, the route was transferred to several



Courtesy of Pioneer Instrument Company

Figure 5: This instrument, the controller of the earth inductor compass, is mounted on the instrument board of the plane, and is set to the predetermined course which the pilot desires to follow



Courtesy of Pioneer Instrument Company

Figure 6: The generator of the earth inductor compass system. This part is mounted near the tail, as shown on the preceding page

charts of large scale. Although Lindbergh had no way of checking his course at sea, he hit his destination "on the nose" on the Irish Coast. His skill in navigating by dead reckoning was truly miraculous!

Lindbergh's Instruments

Excepting always the sextant, Lindbergh carried every possible instrument that could be of real service. The photograph of Figure 2 shows the interior of his cockpit, and the location of these instruments. The top of the throttle is in the lower right-hand corner, and in the extreme lower-right corner is the controller dial of the earth inductor compass. In the center is the control stick and underneath the board are the many valves by which the flier regulated the flow of gasoline from the main and auxiliary tanks. In the board above the instruments are, left to right, upper row: The oil pressure gage for watching of the lubrication system; the earth inductor compass; the altimeter for measuring height above sea level. Left to right, lower row: Ignition switch; tachometer for indicating the revolutions per minute of the engine; bank and turn indicator showing whether the ship was flying on an even keel, and also warning the pilot of minor deviations from his course; air-speed indicator and clock. In the lower center of the board the upright instrument is the fore and aft inclinometer; above it is the lateral inclinometer. The knob at the extreme right is the priming pump. Most of the instruments for the flight were specially made by the Pioneer Instrument Company.

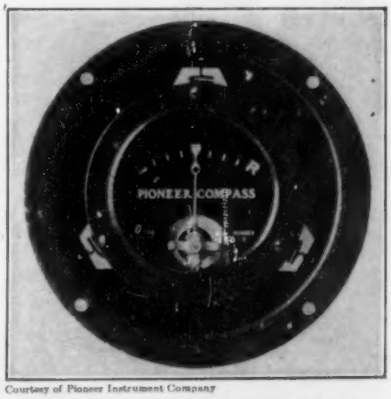
In addition to these instruments, Lindbergh's craft carried an earth inductor compass. The angular variation between the readings of the magnetic field and the true north lies between 10 and 20 degrees. This variation or declination must be kept constantly in mind by the pilot, and corrections varied in accordance with location. When the ordinary compass is employed, there is the further difficulty that it is affected by the iron or steel which may be in its vicinity in the plane. In the earth inductor compass, current to actuate an electric meter is provided by the rotation of an armature in the earth's magnetic field, as shown in the diagram in Figure 4. The compass proper, see Figure 6, can be located at the very tail of the airplane where it is free from all magnetic disturbances of the metallic structure of the airplane but the controller, see Figure 5, by which the earth inductor compass is set to the desired heading, is placed in the cockpit where it may be operated by the navigator. The pilot has only to watch a meter, Figure 7, which shows any departure to left or right of the proper course.

For actual navigation Lindbergh had, besides his compass, his altimeter, air-speed indicator, drift indicator and smoke bombs. It is not yet quite clear that he used the smoke bombs in his flight. Certainly he intended to make use of them as the statement quoted above clearly indicates.

The air-speed indicator is extremely useful to the pilot because it gives him a general idea of the progress he is making, and warns him if he is flying too near to the minimum speed or stalling attitude. However, except in perfectly still air, it does not give the speed over the ground or sea. To get the ground speed and the the drift at sea, the following precedure is followed. A smoke bomb is dropped. The altitude is obtained from the altimeter. The speed meter is set at the indicated height, and the time of transit of the smoke bomb between two set pointers is obtained by sighting and use of a stop watch. The ground speed is then read directly from an appropriate scale.

In the drift meter proper, there is a vane index that passes over an arc divided in degrees. Normally the vane is neutral in the fore and aft plane of the aircraft. If, when sighting through the meter, the smoke bomb appears not to parallel the vane index, the vane is moved until a parallelism is established. Once this condition is established, the angle of drift can be obtained from the arc. Knowing his air speed, ground speed and drift angle, the navigator can easily calculate his exact course—sometimes with the aid of a device which is simply a mechanical means of solving all triangles. Lindbergh probably did not trouble to make exact calculations

(*Continued on page* 181)



Courtesy of Pioneer Instrument Company

Figure 7: The indicator of the earth inductor compass. When the plane departs from the course indicated on the instrument shown in the left column, the needle of the indicator shows the departure

Radio Notes

A Monthly Review of Progress in Wireless Communication

CONDUCTED BY ORRIN E. DUNLAP, JR.

Power Transmission

INCANDESCENT lamps, held or suspended in the air without any connection to electric-power wires, were made to glow brightly when high-frequency waves were directed upon them, in a demonstration of power transmission by radio by two Westinghouse engineers, Dr. Phillips Thomas and Dr. Harvey C. Rentschler, before the New York Electrical Society.

Dr. Rentschler displayed a radio furnace in which chemical reactions were caused by radio waves. Metallic tungsten, among the most infusible of metals, was heated white hot in an instant by the invisible rays.

It was made clear that radio waves like those used in broadcasting, except of shorter wavelength, can be reflected from metal mirrors and confined to narrow beams, in much the same way as the beams of light from an automobile headlight. "We may visualize," said Dr. Thomas, "a parallel beam of radiation ten centimeters, or four inches across, along which is being sent 10 kilowatts of energy. What sort of effects shall we find? Will this be the means for delivering energy for heat and light to individual houses? Improvements in the radio art make it interesting to consider such a possibility. We may imagine each house furnished with a half-wave oscillator in line with a parallel beam from a sending station, so that the heat and light may be obtained very much as at present, by simply turning a switch but without the costly wire transmission equipment now necessary."

Dr. Thomas, before the Electrical Society, generated waves of this type as short as 240 centimeters, or eight feet, which is only about one-hundredth of the wavelength of the shortest waves ordinarily used in broadcasting. He predicted that still shorter waves would be produced, capable of being concentrated into narrow and powerful beams.

The radio furnace demonstrated by Dr. Rentschler is designed to concentrate a large amount of radio power within a very small space. Certain metals cannot be prepared usefully in metallic form by ordinary methods because they are combustible when in the state of fine powders, burning in the air like tinder whenever they are heated. The radio vacuum furnace had made these peculiar metals available, and it is expected that uses will be found for them in industry, according to Dr. Rentschler. He pointed out that one use for the radio furnace would be to turn metals like gold and silver into gases so that their individual atoms might be weighed.

Old Instruments Coming Back

BROADCASTING has brought plenty of forgotten musical instruments into prominence, and has helped to popularize the development of a host of new ones. According to the radio impresarios, the process will continue just as long as musical tools which register through the microphone with new tonal qualities can be discovered or created.

The program director at WEAF is no longer amused when the artist produces from his pocket an instrument bearing a strange seven-syllabled name, or when he states that a truck is outside laden with a musical implement whose name can be recorded in three letters.

Many of the weirdly named instruments are old ones. Others have come recently on the market, but these are usually adaptations or mechanical variations of ancient musical tools. Some of them have proved unsuited to broadcasting, but plenty of them have made established places for themselves in the ranks of instruments well suited to microphone work.

Before the advent of broadcasting, few people had heard of the celeste, although it had always been a part of every full symphony orchestra. The instrument consists of a number of steel plates which are played by being struck with small hammers, a description which sounds considerably less melodious than the sweet tones which the celeste produces in broadcasting. Today the instrument is being used by many popular orchestras in their concerts over the air.

The xylophone, the marimba and the cymbalum, all implements similar in construction to the celeste, have also been brought to fame largely by radio, and the vibraphone, which produces its tones from metal tubes rather than from strings or disks, has been designed especially for broadcasting purposes.

"Almost anything can be played these days," said H. T. Martin of WEAF. "Witness the sweet, swinging tones of a saw when struck with a padded hammer and bent to produce various notes. The cigar-box banjo and the 'one-string fiddle,' made from a cigar box and a broomstick, in the hands of experienced players produce real music of a startlingly 'different' character when heard over the air.

"Other instruments which have proved excellent broadcasters are legion. They include the zither, a form of Irish harp once very popular but little heard of late, until broadcasting came into its own. The dulcimer and the harpsichord, forerunners of the modern piano, are making new musical reputations, thanks to the microphone. Even the jew's-harp is gathering laurels for itself."

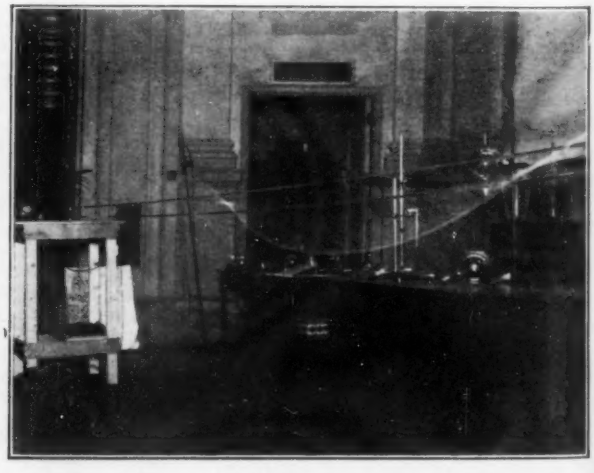
New Condenser

A RADICAL departure in the standard design of rotary variable condensers has been introduced by the Unicontrol Condenser Corporation. The new pre-

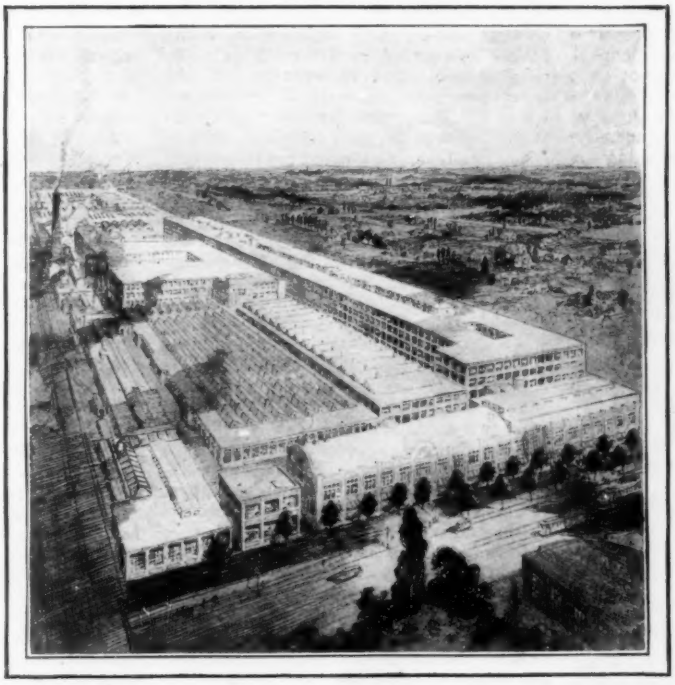
(*Continued on page* 172)

New York Electrical Society

Twenty-four meter transmitting circuit developed by Dr. Phillips Thomas to send power through space in sufficient quantity to light incandescent lamps held suspended in space, thus demonstrating power by radio



Visual picture of radio waves as demonstrated by Dr. Phillips Thomas. The whitish line representing the wave form is produced by a rapidly vibrating rope, set in vibration by means of a small electric motor



The 45-acre reason for the success of Pierce-Arrow trucks

If you could actually see Pierce-Arrow trucks being built—see the type of workman who builds them—see the kind of tools he uses—see the materials and how they are tested . . . you could fully appreciate the hidden values in Pierce-Arrow truck construction.

In this great factory, covering 45 acres—and the various daylight buildings with 1,400,000 square feet of floor space—there is plenty of room for careful, painstaking work, despite the large number of trucks which are built each year.

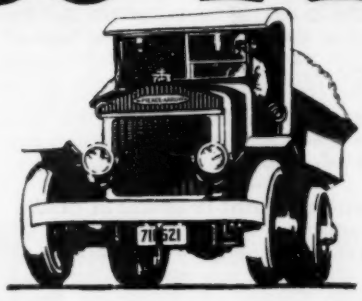
And the Pierce-Arrow workmen . . . how different they are from the average! Some of them have been with the company since the first Pierce-Arrow car was built twenty-six years ago—many from ten to twenty years.

It is because of the traditional quality of Pierce-Arrow; because these men work with patient, unhurried, understanding skill, that these trucks quite commonly keep going ten, twelve or more years.

It *does* make a difference *where* your truck is built—and *who* builds it. . . . THE PIERCE-ARROW MOTOR CAR COMPANY, *Buffalo, New York.*

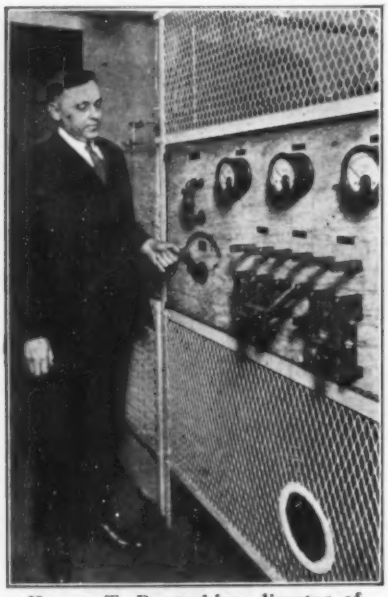
Pierce-Arrow

Dual-Valve... Dual-Ignition



Worm Gear Drive Trucks

cision instrument differs from the old style of stamped plate condenser in that the rotor and stator plates consist of two integral castings. They are proportionally small in size to their capacity, requiring less mounting space; and, while manufactured of a special aluminum alloy which makes them less in weight than the average condenser, there is no possibility of warping or distortion of the plates.



Harvey T. Rentschler, director of research, Westinghouse Lamp Company, with his "radio furnace" used to produce high temperatures by means of high-frequency waves

A special tapering arrangement of the plates is a paramount feature, which allows a perfect straight-line frequency and wavelength without the use of offset plates. An exclusive feature is the capacity adjustment, which permits the condenser to be adjusted individually to the coil after mounting in the receiver, which assures a well-tuned set.

The instruments are manufactured in two types, ranging in capacity from .00025 to .0003 microfarads in the three-plate series and .0003 to .0005 microfarads in the four-plate series. There are no soldered joints or pins; and, therefore, there is no chance for loose contacts or corrosion. By a novel bearing arrangement of the shaft, an even motion of the rotor is assured. Simple provision has been made for mounting the condenser on the panel, and the instrument itself carries suitable terminals for circuit connection.

New Tube Designed for Amplifier Unit

A NEW tube designed to give increased volume in resistance-coupled audio-amplifier circuits has been introduced by the E. T. Cunningham, Inc., to be known as the CX-340.

General operating specifications of the tubes are as follows: Filament voltage, 5.0 volts; filament current, .25 ampere; recommended "B" voltage, 135 to 180 volts, and amplification factor (*mu*), 30.

The CX-340 is a storage-battery tube, with a one quarter ampere, long-life filament of thoriated tungsten. A standard CX base is provided. This tube is intended to give the highest practicable voltage amplification so essential in the resistance-coupled amplifiers. This method of amplification, in contrast with the transformer-coupled method, depends entirely upon the tube for the step-up effect. In transformer coupling, on the other hand, the step-up effect is brought about by the transformer ratio as well as the tube. Therefore, the CX-340 and its equivalent, the UX-240, have been designed to provide an amplification factor of 30.

The over-all amplification of one stage of resistance-coupled amplification, employing the CX-340, is said to be substantially equivalent to the average stage of transformer-coupled amplification utilizing the UX-201-A. This is contrary to general belief which holds that resistance-coupled circuits give such poor amplification that an additional stage or two are necessary to produce satisfactory volume. When a general-purpose tube of moderate amplification is employed, this is admittedly the case. It may also be the case when tubes of a lower *mu* than 30 are employed. But with the CX-340 or equivalent tube in the detector stage as well as in the first stage, there is adequate output to operate a power amplifier at full efficiency.

With the exceptional amplification factor (high *mu*) of the new tube, it becomes possible for amateurs to reduce the resistance-coupled amplification to two stages, namely, the first stage with this tube following the detector employing the same type tube, and the second stage with a power amplifier. The cost of the condenser, plate coupling resistor and grid leak employed in each resistance-coupled stage is only a fraction of the cost of a high-quality transformer.

Resistance-coupled circuits have heretofore been limited in popularity because of the high "B"-battery drain. This was true when the general-purpose type tube was misapplied to resistance-coupled circuits which call for a high *mu* tube. The "B" or plate current drawn by the CX-340, however, is about one-tenth that drawn by the average general-purpose tube employed in the same circuit, even when operating at "B" voltages of 135 to 180, which are essential for proper results with resistance coupling.

Rochester Favorites

IN reply to a question asked by *The Rochester Times-Union*, Rochester, New York, regarding what stations the radio listeners enjoyed outside their own city, the tabulated results show that WJZ led in a list of ten submitted as outstanding.

The following is a list of the ten leading stations and the percentage of replies received toward each: WJZ, 92; WGY, 83; KDKA, 79; WBZ, 77; WGR, 72; WPG, 70; WEAF, 68; WTAM, 62; WBAL, 60; and WLS, 58. The vote was specifically limited to stations outside of Rochester.

British to Print Programs in Braille

AN appeal for funds to enable the printing of radio programs in Braille for blind radio fans was recently broadcast in England by Captain Sir Beachcroft Towse, over the stations of the British Broadcasting Company. The project met with the approval of the National Institute of the Blind and the broadcasters promised their aid in giving out the program material in advance of regular publication so that the embossing in Braille may be accomplished in time. It is expected that if sufficient funds are procured, the blind radio fans of Great Britain will be supplied with the broadcast schedules at about $1.50 per annum.

Another step, recently taken in England to insure the blind of radio entertainment, was the passage of an act which entitles all blind radio listeners who are properly registered to forego the payment of the annual license fee. This act was projected successfully by Captain Ian Fraser, a blind member of Parliament. Some 25,000 to 30,000 persons are estimated to have benefited by this act.

Radio Engineering

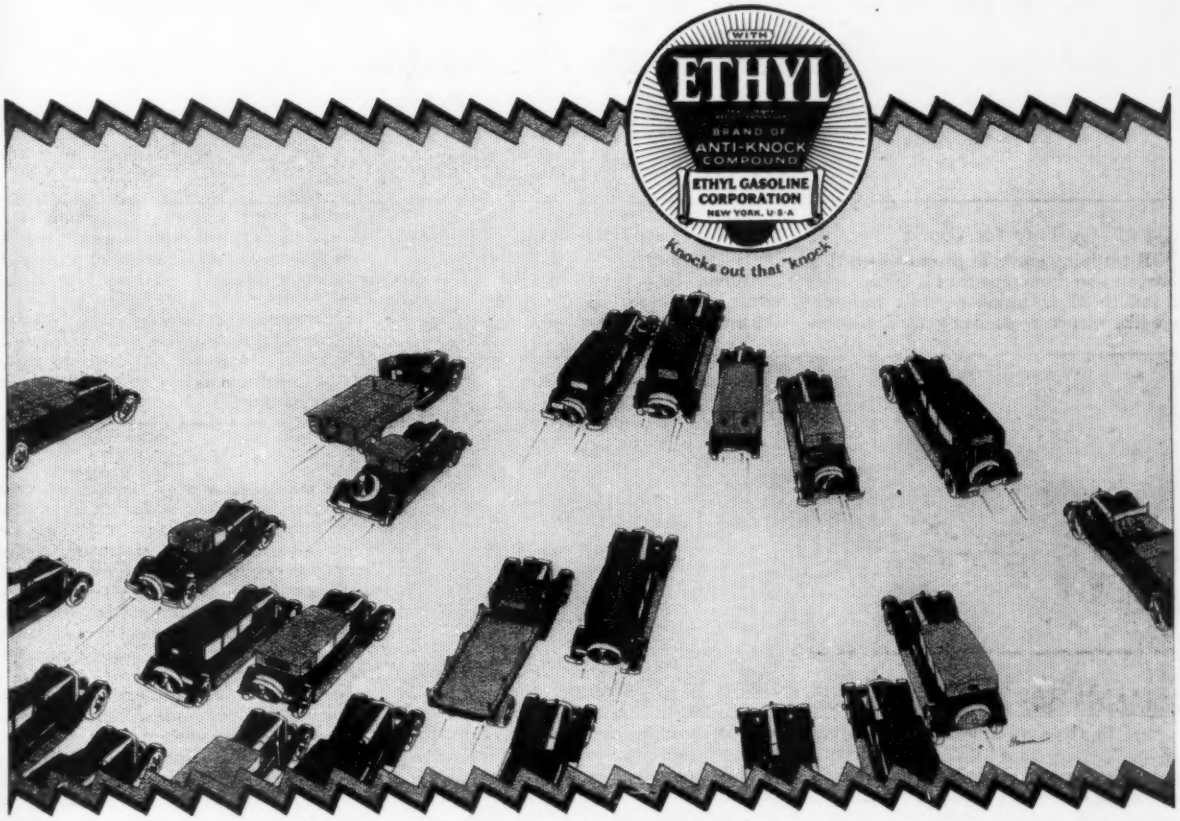
THERE is not a widespread knowledge of the real qualifications of a radio engineer, according to Dr. Alfred N. Goldsmith who proposes the following definition: "A radio engineer is an electrical engineer who has first specialized in communication engineering, and then sub-specialized in radio communication."

"Guided by this definition, it is clear that the fundamental training of a radio engineer is that of an electrical engineer," said Dr. Goldsmith. "His first specialization should be in the field of alternating-current phenomena at high frequencies and the characteristics which are displayed to such currents by networks and systems having concentrated or distributed electrical constants. If elective courses on advanced transformer design and, under the division of physics, on acoustics, are available, the student will do well to choose these.

(*Continued on page* 180)

New York Electrical Society

A vacuum tube with which it is possible to produce intense heat by means of concentrated Hertzian waves. Radio-frequency electric currents passed through the copper coil inside the bulb create the waves. A disk of metallic tungsten at the center of the coil absorbs the waves and causes the disk to become white hot in an instant



Get the benefits of *high compression*

AUTOMOTIVE engineers have long known that the efficiency of gasoline engines increases as their compression is raised.

The compression of the present day automobile is as high as the limitations of ordinary gasoline permit. Gasoline is not a perfect fuel. It explodes too soon (*i. e.*, "knocks" and loses power) when compressed beyond certain limits.

That is why automotive research devoted many years to the development of "ETHYL" fluid, which, when mixed in very small quantities with motor gasoline, eliminates its knocking tendencies and makes it a high compression fuel. The fuel so mixed is Ethyl Gasoline.

Ethyl Gasoline has brought the benefits of high compression — greater power and flexibility, faster pick-up, reduced gear-shifting — to hundreds of thousands of motorists. This is because carbon deposits raise the compression of your engine beyond the point at which it was designed to perform efficiently with ordinary gasoline.

Try Ethyl Gasoline to-day. Enjoy a driving satisfaction and engine performance that you have never before experienced with your car. The "ETHYL" trademark shown above identifies the Ethyl Gasoline pump.

What high compression means to you

THE principle of high compression is readily understood. The tighter you pack the powder charge in a muzzle loading gun, the greater the force given the bullet. Similarly, the tighter gasoline vapor and air are compressed in the combustion chamber (the space between the head of the cylinder and the top of the piston) before ignition, the greater the power derived from the explosion.

Increasing compression therefore simply means decreasing the size of the combustion space, which may be accomplished mechanically or through the formation of carbon.

Higher compression means a more powerful and flexible car, less gear-shifting, faster pick-up. In short, a performance impossible with lower compression and the use of ordinary gasoline.

ETHYL GASOLINE CORPORATION, 25 BROADWAY, NEW YORK CITY

ETHYL GASOLINE

Applied Science for the Amateur

A Department Devoted To the Presentation of Useful Ideas. Material of Value To All Will Be Found Here

CONDUCTED BY A. P. PECK

A Trap for Crows

FOR trapping crows in places where they become so numerous that it is necessary to reduce their numbers, this immense cage-like structure is being used successfully. The trap is about six feet in height and of any desired size. The trap is covered with poultry wire, and after a number of crows have entered it to eat the corn sprinkled on the inside, a wire operated from a blind closes the gates. *Contributed by Allen P. Child.*

In the center of the field is one of the crow traps described here

Silver Soldering

THE proper method of soldering two pieces of silver together is admirably put forth by F. Capello in a recent issue of the *General Electric News*. We recommend this system to our readers, and reprint Mr. Capello's directions below.

"First, the surfaces to be soldered should be thoroughly cleaned by filing, sandpapering or otherwise.

"Second, the flux to be used should be borax, fused or commercial, and silver solder. The borax should be pulverized and mixed with water to make a paste of the consistency of light cream. Should the paste become hard before use, thin with water.

"Third, moisten the surfaces to be soldered with clean water and apply sufficient borax paste to cover the joint. In applying the paste, it is best to use a round steel or iron rod about one eighth inch in diameter by 10 inches long, which for convenience should be flattened at one end to spread the paste before heat is applied and pointed at one end to dip into the paste to guide the flowing silver where required.

"When ready to apply the torch, care should be exercised to heat the borax slowly, as if heated too quickly it has a tendency to spit and sputter and may burn skin or clothing. When the borax puffs up like a grain of popcorn and then begins to shrink, apply the heat gradually until using full capacity of the torch.

"When the parts are cherry red, apply silver solder to fill the joint or gap. Do not use the solder to assist the flow, as the flame may melt the silver bar, causing a bad looking joint as well as loss of silver. Use the small rod.

"Having completed the operation, dip the article into hot water to assist in removing the borax from the surface. If it is not possible to dip the article because of its size, use a sponge or piece of waste with hot water and wash the surface."

The "Florida Floater"

AN inexpensive float that will furnish many hours of fun at the bathing beach may be made by any ingenious boy or girl. The device as illustrated in these columns is made from two poles eight or nine feet long, two cross-bars, some cloth for the seat, and two automobile inner tubes capable of holding air. These are all assembled as shown. A double bladed paddle can be made from another pole and two short pieces of plank.

I designed this floater for my niece, who appears in the photograph, and after it was put to use, it was found to be capable of supporting the weight of seven adults, thus proving its safety. *Contributed by Lydia Allen DeVilbiss, M. D.*

Protecting Battery Terminals

THE following method of preventing the corrosion of storage-battery terminals will be found to be perfectly effective. After the cable has been fastened to the terminal, shape a cardboard form so that it will enclose the terminal and a small part of the cable. Pour melted paraffin into this form so that the terminal is completely covered by the wax. Allow to harden, and remove the form. Before this work is started, the terminals should be carefully scraped clean and then washed with either ammonia water or a solution of baking soda. *Contributed by A. A. Fonken.*

[The wax used for sealing storage-battery cells would probably be better for use in this work. It would not tend to soften or run in warm weather as would paraffin. *The Editor.*]

A "Mouse-Fish"

A MOUSE is one of the easiest creatures to tame, although it is true that there are very few uses for him after he is trained. However, a few years ago, some telephone workers were most grateful to the tiny rodent who helped them out of a difficulty that had tied up the job for most of two days. They were trying to run a conduit through a narrow pipe and around a bend without much success, when someone suggested rather idly that they send a mouse through with it.

First catching a mouse, they tied a "fish" wire to his tail and fastened this in turn to a piece of metal tape. All that remained to be done was to make the mouse run through the pipe; time after time he started only to turn around and come back. Finally by blowing sulfur fumes through the open end behind him, the workman induced their little pet to run through, dragging

(*Continued on page* 178)

The "Florida Floater" is easily made from odds and ends and affords much pleasure to its user at the bathing beach

Old Briar

TOBACCO

"THE BEST PIPE SMOKE EVER MADE!"

CAN YOU IMAGINE this surging theatre throng along Broadway all agreeing on *one* star as the greatest? Of course not! Yet this throng is but a fraction of vast multitudes of smokers who are welcoming and praising *one* pipe tobacco—Old Briar—as "the best pipe smoke ever made."

THE most convincing thing in the world about Old Briar Tobacco is the whole-hearted praise of the smoker himself. It's just plain common sense that pipe smokers are turning to the best tobacco they can get. A pipeful of Old Briar costs so little, they are entitled to it!

Light up *your* pipe full of Old Briar. Draw in the ripe fragrance of this wonderful tobacco. Enjoy its full, pleasant aroma—its extra smoothness—its comfort. Smoke it awhile. Notice how mild and cool it is—how completely satisfying! Now, you know why a world of pipe smokers are welcoming Old Briar—the ladies, too, enjoy its fragrance.

It has taken years of scientific knowledge in the art of mellowing and blending, and generations of tobacco culture, to produce Old Briar. Step by step Old Briar has been developed—step by step *perfected.*

And, every day, thousands of pipe smokers are proving for themselves that Old Briar is the best pipe smoke they ever had.

IF YOUR DEALER DOES NOT HAVE OLD BRIAR

Tear out this coupon and mail to:
United States Tobacco Co., Richmond, Va., U.S.A.

SPECIAL OFFER: It costs so little to smoke a pipeful of the best Tobacco ever made, you are entitled to enjoy it. We will mail you the regular OLD BRIAR 50c Humidor Box on receipt of this coupon with your name and address. In addition, we will send you a 25c pocket package of OLD BRIAR—extra—if you send us your dealer's name. Send no money, but pay the Postman only 50c when he delivers the tobacco.

Print Name .....

Address .....

City and State .....

Your Dealer's Name .....

Address .....

If you prefer—send stamps, money order or check with coupon. Tear out the coupon now, while it's handy.

A world of pipe smokers have learned for themselves that a pipeful of OLD BRIAR costs only a fraction of a cent more than a pipeful of ordinary tobacco. Of all the pleasures man enjoys, pipe smoking costs about the least.

TO DEALERS: *Old Briar is sold in Pocket packages at 25c and Humidor boxes at 50c, $1.00 and $2.00. If your jobber has not supplied you, write us and we will send you a supply by prepaid Parcel Post at regular Dealers' prices. Every box and package of Old Briar has our unlimited guarantee.*

UNITED STATES TOBACCO COMPANY, RICHMOND, VIRGINIA, U. S. A.

Are You An Inventor?

If so it is essential that you own a copy of the latest book on the subject. One which includes the experience of many years, garnered from the long list of inventors who have been successful despite the errors and pitfalls which threaten those who do not avail themselves of counsel and advice. A most readable presentation.

Inventions and Patents

Their Development and Promotion

By

Milton Wright

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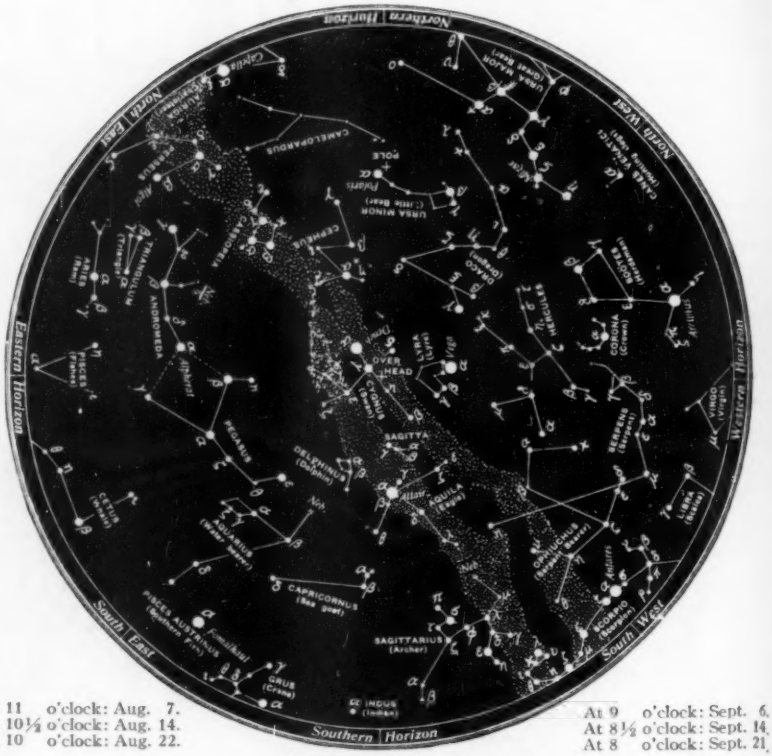
SCIENTIFIC AMERICAN

The Heavens in August

By PROF. HENRY NORRIS RUSSELL, Ph.D.



At 11 o'clock: Aug. 7.
At 10½ o'clock: Aug. 14.
At 10 o'clock: Aug. 22.
At 9½ o'clock: Aug. 29.
At 9 o'clock: Sept. 6.
At 8½ o'clock: Sept. 14.
At 8 o'clock: Sept. 21.

The hours given are in Standard Time. When local summer time is in effect, they must be made one hour later: 12 o'clock on August 7, etc.

NIGHT SKY: AUGUST AND SEPTEMBER

The Planets

THIS month Mercury is a morning star and can best be seen on or about the 8th when he is in his greatest elongation, 19 degrees from the sun, rising about 3:15 A.M., standard time (all the times given here are standard time, taking no account of daylight saving time). Being north of the sun and very bright—equal to Vega—Mercury should be easy to see. Toward the end of the month he is lost to view.

Venus is still an evening star and is at her greatest brilliancy, eleven times as bright as Sirius. She remains in sight till 8:45 at the month's beginning, but at the close she sets at 6:50, and is practically lost to view. Telescopically she is a narrow crescent of large size, her diameter from horn to horn measuring from 35 to 55 minutes of arc, so that the crescent phase can easily be seen with a good binocular.

Mars is also an evening star, setting before Venus for most of the month. But later, toward its close on the 27th, the two planets are in conjunction, although by no means closely, their least distance being nearly 9 degrees.

Jupiter is in Pisces and is beginning to get into the evening sky. He rises at 9:40 P.M. on the 1st, and 7:40 on the 31st.

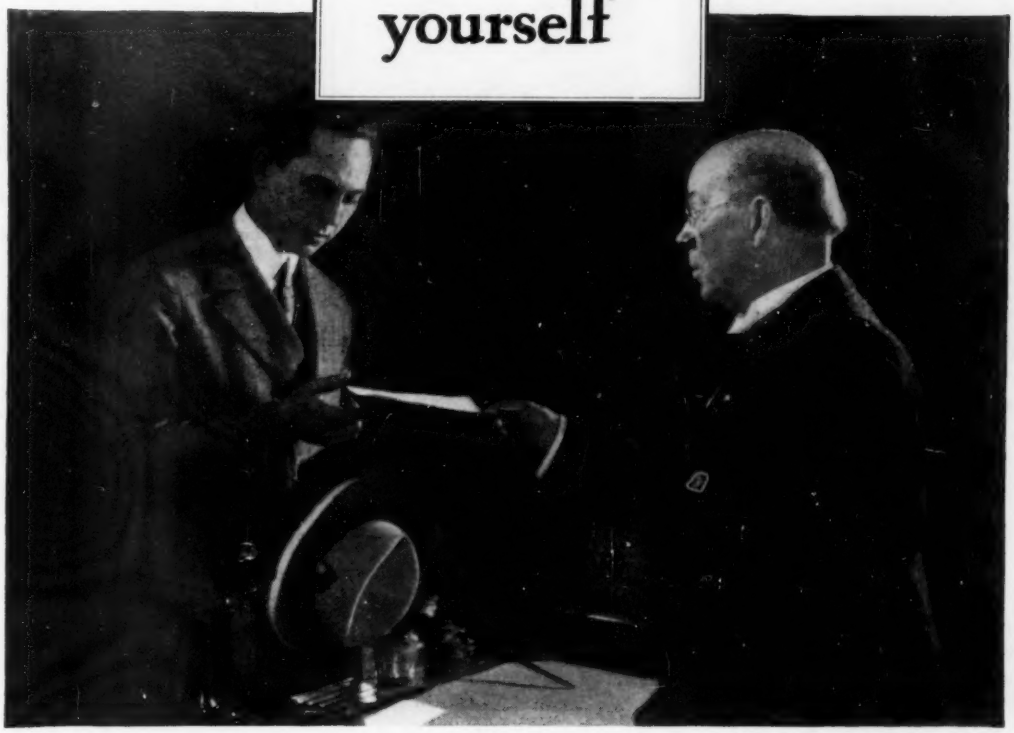
Saturn is in Scorpio and is in quadrature east of the sun on the 25th, on which date he is due south a little before 6:00 P.M.

Uranus is in Pisces, close to Jupiter. On the 19th the two planets are in conjunction, Uranus being only 50 minutes of arc north of Jupiter. This affords an excellent opportunity for the amateur to identify the remote planet. Although visible to the naked eye on a clear dark night when isolated, Uranus when so near Jupiter will be hopelessly invisible without a good binocular. All through the month these planets are close together in the sky; on the 1st Uranus is about 28 minutes west and 32 minutes north of Jupiter. In actual brightness, to our eyes, Uranus is inferior to Jupiter's brightest satellite, although he is really ten times the diameter of the satellite, and at the same distance he would look about 100 times as bright. But since he is more than three times as far away from the sun, and four times as far from us, he appears fainter.

Neptune is in conjunction with the sun on the 21st and is therefore invisible this month.

The moon is in her first quarter at 12:48 P.M. on August 5th; full at 11:37 P.M. on the 12th; in her last quarter at 2:54 P.M. on the 19th; and new at 1:45 A.M. on the 27th. She is nearest the earth on the 15th, and farthest off on the third, and again on the 31st. During the month she passes through conjunction with Saturn on the 7th; Uranus and Jupiter on the 15th; Mercury on the 26th; Neptune a few hours later; Venus on the 28th; and Mars the same evening, these two planets being almost in conjunction at that date, as stated above.

don't fool yourself



It may get you "fired"

More and more, employers are insisting that people about them be not only neat, but *inoffensive.*

Halitosis (unpleasant breath) is responsible for many a good man and woman being "let out."

Nearly everyone is halitoxic at one time or another and since you, yourself, cannot tell when you have it—and friends *won't* tell—the safe thing to do is to use Listerine every day, especially before personal contacts.

1/3 Had Halitosis

68 hairdressers state that about every third woman, many of them from the wealthy classes, is halitoxic. Who should know better than they?

Face to face evidence

Immediately it destroys unpleasant odors arising from teeth and gums—the most common source of halitosis. And the antiseptic essential oils combat the action of bacteria in the mouth. Better keep a bottle handy in home and office, so that you may always be sure. Lambert Pharmacal Company, St. Louis, U. S. A.

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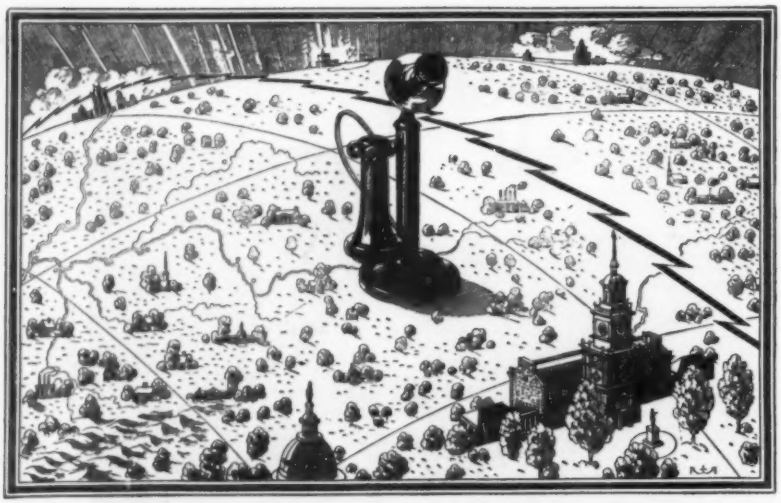
IS THERE ANY?

What is the point of paying more when Listerine Tooth Paste is a scientifically correct dentifrice and sells for 25c for a large size tube?



The Traveler's Telephone

An Advertisement of
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AMERICANS are the greatest travelers in the world. They have knit the country together by steel rails and made it the largest and most prosperous business community the world has ever seen. Business, friendship and political solidarity are maintained by personal touch, by travel and the telephone.

Wherever the business man goes in this country, be it thirty miles or three thousand, he is still within earshot of his office, his family and his friends. He can get them and they can get him, and for the longest call in the United States the day rate is only $12 and the night rate is only $8.

For the Bell Telephone System is an idea in force nationally. All the instruments are designed in the largest industrial laboratory in the world and made in the same factories to the one standard of fitness. All of the telephone builders, repairers and operators are trained to the same ideal and aim; stated by President Walter S. Gifford as:

"A telephone service for the nation, so far as humanly possible free from imperfections, errors or delays, and enabling at all times anyone anywhere to pick up a telephone and talk to anyone else anywhere else, clearly, quickly and at a reasonable cost."

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He is one of the many men who have sent for a remarkable book, *"The Nestler Plan."* It tells how you too can establish a money-making business all your own, servicing tires by the patented Nestler Rubber Fusing Process. You can easily learn this scientific, modern rebuilding and repairing method in your spare time. Big profits; protected territory; little capital required; no experience necessary.

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the wire and tape. Cheese in large quantities was set before him as a reward and he remained about the place, tame as any cat, for several days afterward, looking for more food—perhaps for another job!—*Contributed by Mrs. F. H. Waldo.*

[According to the contributor, this incident is vouched for by the telephone company's officials of Manden, North Dakota. If anyone else attempts a similar use for a mouse, it is our suggestion that a thin cord be attached first to the rodent's tail, possibly using adhesive tape as the fastening medium. This cord can later be used to pull the "fish" through. There is no doubt in our minds but that this simple system will work.—*The Editor.*]

Tagging Cables

BATTERY cables on radio sets and similar electrical installations are difficult to "trace out" when terminals happen to come loose, or are disconnected for repair purposes. To make sure that the connections are always replaced in their

Attaching tags to battery cables and the like, as shown, prevents the possibility of making wrong connections to terminals

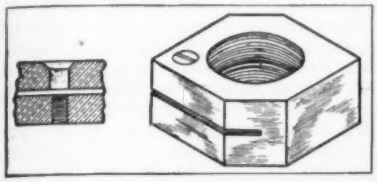
correct locations, each wire of the cable should be tagged when first put into service. If each end of each wire is tagged and noted, there will be no possibility of making wrong connections in the future. The system is illustrated in these columns.

Lock Nut

A CASTELLATED nut and cotter pin can not always be employed where it is necessary to use a lock-type nut. Numerous times the space is rather limited and the height of the nut must be taken into consideration. Again comes the time when a nut is to be inserted in a counterbored hole and tightened. Here the difficulty of inserting the cotter pin presents itself. On some type of machines, the working arms pass close to the body of the machine and here clearance must be considered. Only a flat type of nut can be used but difficulty presents itself in the locking of such a nut.

Such situations may be readily overcome by the use of a special type of lock nut which is locked in place by a flat-head machine screw inserted in one corner of the nut. To make one of these, cut down through the center of the nut with a hack saw to a depth of a little more than one half. Then drill one corner of the nut for the particular size of machine screw to be used, the size to be governed by the size of nut used. Tap the bottom half of the hole and make the upper half

slightly larger than the threads of the machine screw. Countersink the hole at the top. After the nut has been tightened on the bolt, draw up on the machine screw with a screw driver. This will tighten the two sections of the nut against the threads of the bolt and com-



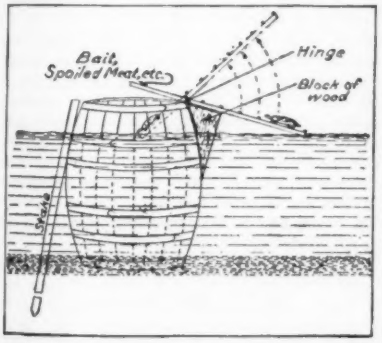
A lock nut designed by one of our readers. Tightening the machine screw draws the halves of the nut together and locks the threads, preventing the nut from turning

pletely lock the nut until the machine screw has been removed. *Contributed by Peter Hagen.*

An Efficient Turtle Trap

THE turtle is a great destroyer of fish eggs, and if you are to have a good fish pond, says the Kentucky Game and Fish Commission, according to *Field and Stream*, the turtles must be removed. Here is a handy, cheap trap that can easily be made by anyone.

The board should be attached to the top of the barrel by a free-working, ordinary strap hinge, and almost on a balance, so when the turtle climbs up to get the bait, the end over the barrel will tilt, and drop him into the empty barrel. The other end

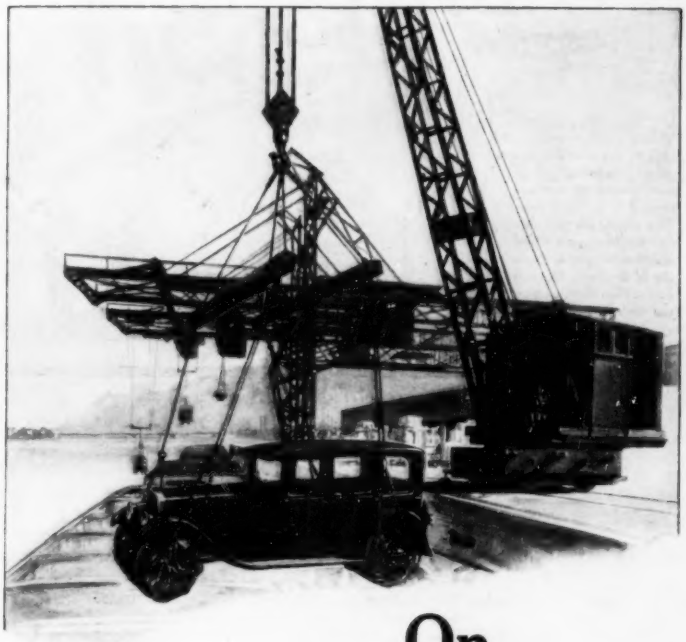


Trapping turtles is easy with an arrangement such as that shown above. Climbing after the bait, the turtle is tipped into the barrel, from which it can be removed at leisure

will then drop back on a level with the water, ready for another victim. Cleats should be placed on the tilting board so the turtle will not slip off when climbing up.

Riveting

WE all know of the destructive force of vibration, but do we all apply this knowledge in our work? For example, when metals are riveted together, do we always make tight joints so that there will be no danger of vibration? One of the points of riveting that escapes the attention of the average amateur mechanic is that the holes for the rivets must be just large enough for the rivets to be pressed or lightly hammered into place. Then there will be no play in the finished job, and the possible effects of vibration will be eliminated.



On Municipal Docks

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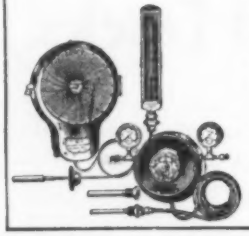

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Radio Notes

(*Continued from page* 172)

"The sub-specialization in radio engineering will deal with the theory and construction of the specialized circuits used in radio transmitting and receiving apparatus, together with a careful study of that universal device, the triode, or three-electrode tube. A great deal of emphasis should be placed on the laboratory side of the work because the field is new and rapidly changing, and only those who have had direct contact with actual equipment will be spared the continual mortification of embarrassing mistakes based upon too slavish a reliance on narrow theoretical considerations.

"There are today relatively few universities giving training in the field of radio engineering, which, perhaps, is just as well, since the absorption of trained men in the radio-engineering field (despite public interest in this field) is rather limited. It may be added that a radio engineer, on graduation from the university, is only qualified to begin his career in a somewhat humble capacity, since he must get experience in the test, design and manufacturing divisions of a commercial organization of some scope before he can be depended upon to meet the requirements of this fairly difficult profession. However, it is a most interesting field and the workers in it feel that they are in the van of progress."

A Good Record

BLOOMSBURG, Pennsylvania, must be a good place for ideal radio reception according to a record established by G. E. Elwell, Jr., of that town. He picked up station KFI, Los Angeles, on 200 consecutive nights. The log which he forwarded to the station for verification checked exactly with the programs as broadcast, according to officials at the station. Bloomsburg is 2,400 miles from Los Angeles. Mr. Elwell's record of reception is 496 stations. The total distance from his home to the broadcasters he has heard is estimated at 321,000 miles.

No Fear of Saturation

A SURVEY based upon questionnaires sent to 25,000 substantial families in 25 cities by the New York University Bureau of Business Research, revealed that only 36 percent of the well-to-do families, 97 percent of whom own automobiles, have radio receivers. It is estimated that 64 percent of these families are prospects for high-priced receivers.

The bureau's report says, "It is quite evident that the well-to-do urban dwellers in the United States are far from being 'sold' on radio apparatus."

2XAF Schedule

NUMEROUS requests from foreign listeners, particularly radio fans in the tropics and south of the equator, have led to the expansion of the schedule of 2XAF, the 32.77-meter transmitter of the General Electric Company at Schenectady, New York. 2XAF broadcasts the programs of WGY on the following schedule: Tuesday, 6 to 11.30 P.M., Eastern Standard Time: Thursday, 6 to 12.30 P.M.; Saturday, 6.30 to 12.30 P.M.

Lindbergh's Transatlantic Flight

(*Continued from page* 169)

but trusted, like many pilots, to a certain "feel" of these various instruments.

Lessons of the Flight

While Lindbergh was entirely successful by a wonderful combination of skill, pluck and youth, this does not indicate that the day of transatlantic commercial air services has already arrived; still less that there is an immediate possibility of an early New York to Paris air service.

The flight from San Diego to New York and from New York to Paris, demonstrated the most wonderful reliability of the modern aero engine, particularly in its air-cooled form. Considering that the Wright engine stood up for 21 hours and 45 minutes across the continent, and for over 33 hours across the ocean, in every sort of weather and temperature conditions, while operating at close to its rated power throughout, its reliability is nothing short of miraculous. Nevertheless, a multiple-engined power plant will most certainly have to be employed for transatlantic work. Three engines at least, perhaps five or even seven, will have to be employed.

Lindbergh's plane, heavily loaded with gasoline, just barely managed to get away from Mineola. It carried no relief for the pilot, no special navigator, and absolutely no pay load. Even Byrd's plane, though it had a larger crew, had nothing to spare for commercial pay load. It seems quite clear that if a commercial air line is to be established between New York and London or Paris, there must be intervening stops. Stops at Newfoundland and Ireland for refuelling would lengthen the time of the voyage by an unimportant amount, but they would cut down by half the amount of gasoline to be carried, and allow the carrying of passengers, mail and freight.

There are many present-day ships capable of such a non-stop flight from Newfoundland to Ireland. It cannot, however, be said definitely that they are already so efficient as to make such a service profitable. Nor are the seaplanes that have already been built, so large and so seaworthy as to be entirely immune from the results of a forced landing. If larger seaplanes are built, they become less, rather than more efficient than smaller craft. The structural weight of the larger craft begins to bear a prohibitive ratio to the gross weight of the plane, and the aerodynamic efficiency diminishes likewise. Designers must start anew, and think of machines in which practically nothing remains but a huge wing, with engines distributed along the span so as to reduce stresses and structural weight. Or they may turn in the direction of triplanes. Or even perhaps in the direction of tandem planes, where the wings are distributed along the length of a huge hull and concentrated loads are thus lessened. However, tandem planes will probably wait till monoplane possibilities are entirely exhausted.

It may be said that, since Lindbergh achieved successful navigation by using only part of the methods now available, the problem of successful navigation is almost completely solved. The only possible danger lies in fog. In fog, both sighting of the earth's surface and sighting of the sun becomes impossible. To meet this difficulty airplanes will have to be equipped with powerful radio sets and be

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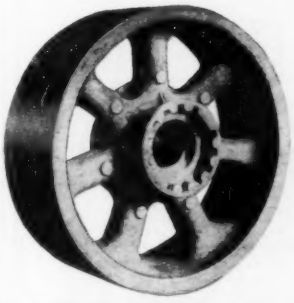
DAYTON STEEL WHEELS



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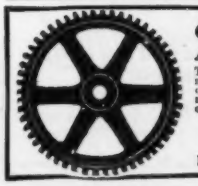

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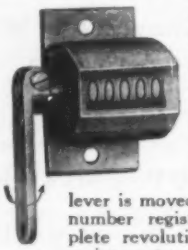
This Small Rotary Ratchet Counter (No. 6) counts reciprocating movements of the lever, as required for recording the output of many small machines. When the lever is moved through an angle of 40 to 60 degrees, the counter registers one. The further the lever is moved, the higher the number registered. A complete revolution of the lever registers ten. This counter can be adapted to no end of counting purposes, by regulating the throw of the lever. Price, $2.00. (*Cut nearly full size.*) Small *Revolution* Counter of similar model, also $2.00.



This large *Re-Set Rotary Ratchet Counter* records the output of punch presses, metal-stamping machines and others where a reciprocating movement indicates an operation. Registers one for each throw of the lever, and sets back to zero from any figure by turning knob once round. Provided with from four to ten figure-wheels, as required. Price with four figures, as illustrated, $11.50. (List.) Equipped with lock and keys to prevent tampering with the record, $2.00 extra. (*Cut less than half size.*) Set-Back *Revolution* Counter of similar model, $10. (List.)

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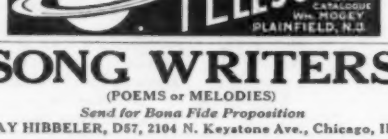

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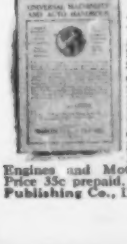

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able to get their bearings from shore stations and from surface vessels. There should be no difficulty in this. It is merely a matter of applying existing methods.

There must also be better meteorological service. For summer months, our knowledge of North Atlantic meteorology is perhaps already adequate. But for all-year-round flying, such service must be vastly improved. When Lindbergh set off he had favorable reports. But the weather men did not inform him of the sleet-filled clouds off Newfoundland which proved his greatest peril. The Weather Bureau can at present secure better information by special arrangements with radio companies and surface vessels. A complete system must be organized for such collection of data.

The suggestion has also been frequently made that floating stations be provided for emergency and refuelling purposes.

On the whole Lindbergh's flight will give a tremendous impetus to commercial attempts to conquer the Atlantic. Granted multi-engined power plants, huge seaplanes in which structural problems have been so carefully studied that size means no decrease in efficiency, systematic weather service, and radio aids to the navigator, we see no reason why, in a very few years, a transatlantic mail or passenger service may not be as feasible as one across the continent is now.

Air-cooled Engines for Aircraft

(*Continued from page* 151)

themselves to be at no great disadvantage.

The theoretical advantages of the air-cooled, vee engine over the radial are being confirmed by experimental results. In return for a slightly higher (at the moment) weight-horsepower ratio, the air-cooled, vee engine offers reduced head area, increased smoothness of operation, higher maximum crankshaft speeds, more readily adjustable degree of cooling, and simplified installation problems. These advantages are increasingly important in the larger sizes. We shall probably discover before very long that some compromise between the two is more desirable than either the vee or radial, but at present the radial, air-cooled engine appears to possess the majority of the advantages in small powers, the vee in the intermediate range and the X in the high-power range (1000 horsepower and above).

This vindication of the air-cooled, vee engine has led to the development by aircraft engine manufacturers of at least two air-cooled, vee engines now in the design stage. The success of the air-cooled Liberty engine has also led to the development by the Engineering Division of a 24-cylinder X type engine of 4520 cubic inches displacement, rated conservatively at 1200 horsepower at 1800 revolutions per minute. Single-cylinder tests of the X engine cylinder have produced highly satisfactory results which indicate that the completed engine can be expected to develop its rated power at 1600 revolutions per minute or even below that figure.

There are also in development two rather unconventional types of air-cooled radial engines, the Cam engine now being developed by the Fairchild Caminez Engine Corporation and the Kinney radial engine under development for the Navy. Both are, on the whole, very promising types,

but still largely in advanced experimental status. The Cam engine is a 150-horsepower radial in which a double-lobe cam replaces the crankshaft. The cylinders are of the screwed and shrunk aluminum-head type, employing the Engineering Division type M cylinder head on a special barrel. The Kinney radial was developed at the request of the Navy for training purposes. It was originally designed as a sleeve-valve, five cylinder, radial engine. The design was modified after preliminary tests and now incorporates a bolted-on head cylinder with an improved hydraulic (oil operated) valve gear.

The present status of the air-cooled engine in this country can be summed up rather briefly. There are two air-cooled radial engines in production status, the 400-horsepower Pratt-Whitney Wasp and the 200-horsepower Wright Whirlwind. There are two more air-cooled radial engines of approximately 425 horsepower in service test status—the Wright P series and the Curtiss R-1454. There are in promising experimental status at least five more radial engines, ranging in power from 60 to 600 horsepower. There is in service test status also one two-cylinder opposed air-cooled engine, the Wright Morehouse M-80. In the air-cooled vee and X types there are in service test the air-cooled Liberty of 430 horsepower, and in experimental status the Engineering Division 1200-horsepower X engine and at least two air-cooled vee engines capable of developing approximately 500 horsepower.

There seems now to be no unwillingness on the part of aircraft - engine manufacturers to engage in air-cooled engine research and design. Whereas several years ago it was difficult enough to buy experimental work on air-cooled engines, today we can easily name at least six projects by nearly as many companies, which have been undertaken and probably will be carried completely through the experimental stages without support or assurance of support by aircraft engine buyers. The air-cooled engine is certainly being given an opportunity to prove itself, and present-day results appear to vindicate the work involved.

Byrd's Preparations

A transatlantic flight which will differ in its significant aspects from those successful flights of Lindbergh and Chamberlin is, at the time of writing, marking time and awaiting the arrival of propitious weather. This flight is under the direction of Commander Richard E. Byrd and is sponsored by the America Transoceanic Company. The plane is a huge three-engined Fokker, using air-cooled Wright "Whirlwind" engines and carrying 1300 gallons of gasoline. It will transport four men and the first official transatlantic air mail, consisting of 200 letters. Radio equipment, life rafts, medical supplies, et cetera are to be carried, and these facts will show, if the flight is successful, one more great step toward transatlantic aerial freight service. When the flight has been completed, the SCIENTIFIC AMERICAN will carry a complete report of it and of the plane that accomplished the feat.

—The Editor.

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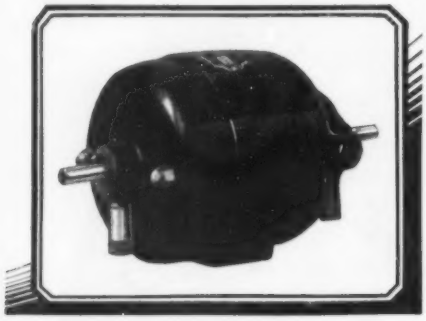

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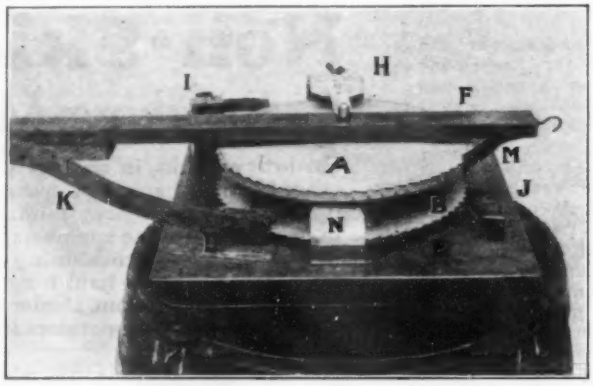
Automatic Machine Makes Telescope Mirrors

IN the June issue, page 424, we published a letter describing a telescope made on an automatic grinding and polishing machine invented by an amateur of our acquaintance, who signed himself "A Wellesley Enthusiast." We promised our readers to forward letters to this gentleman, but so very many inquiries were received that he was forced to defer the requests for individual descriptions and send us for publication a single description that would suffice for all. Machines, as such, for doing this sort of work are not new; but this one is wholly original. If you make one of these machines the telescope editor, and through him the inventor, would greatly appreciate detailed word about its performance. The inventor describes the device as follows:

"It is probably unsportsmanlike for the amateur telescope maker to consider anything in the way of a machine to help him with the tedious work of grinding and polishing his mirror. There are, however, renegades, and I am one of them.



The grinding and polishing machine at work. Power is transmitted through the wooden arm which extends to the left, out of the picture. It may be given a slow reciprocating motion by a crank or any mechanism devised by the amateur. In operation, the upper disk A turns clockwise; the lower disk B, counterclockwise

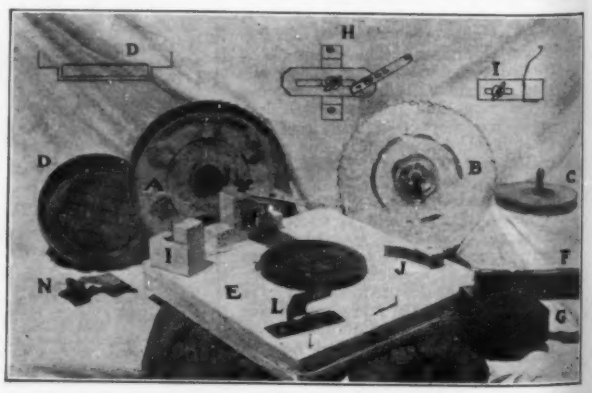
"The pictures show a simple form of machine which almost anyone could make in a day or two from material taken from the scrap heap. One of them shows the machine ready for operation, and the other one shows the separate parts.

"What seems to be a novel feature in this machine is the immersion of the rubbing surfaces in the grit or rouge mixtures, thus eliminating the necessity of constant attention.

"Most of the sheet metal work is made of number 22 B. and S. gage galvanized iron.

"The lettered parts are as follows:

A: Disk with 63 teeth cut in the



Parts of the machine shown in the illustration above. In conversation with the telescope editor, the inventor emphasized strongly the necessity of keeping the rouge evenly distributed in the liquid. Unless full attention is given to this point, trouble will be had. If you duplicate this machine, please advise us how it works

edge to form a ratchet wheel. On the lower side is soldered a dust rim and six clips to grip the mirror holder *C*.

B: Similar to *C* except that it has 60 teeth and the six clips are on the upper side to hold the pan *D*. The lower side has rigidly fastened to it a spindle for insertion in the base *E*.

C: Cup-shaped mirror holder with a rigid spindle, which when assembled passes through disk *A* and connecting rod *F*. The rim on the inside has three pieces of rubber, spaced at regular intervals and fastened with shellac. Over the mirror is placed a disk of rubber (old inner tube) to serve as a cushion.

D: Recessed tray for holding the lap and grinding or polishing mixture.

E: Wooden base with central hardwood turntable.

F: Connecting rod for transmitting a reciprocating motion. (60 strokes a minute is a satisfactory speed.)

G: Wooden block to be fastened to the face plate of a lathe or other rotating device to impart motion.

H: Adjustable guide.

I: Adjustable pawl for turning disk *A*.

J: Pawl to prevent backward motion of disk *B*.

K: Pawl for turning disk *B*.

L: Guide for controlling pawl *K*.

M: Pawl to prevent backward motion of disk *A*.

N: Stirring device of hard wood, mounted on a flexible and readily detachable arm.

"An inspection of the pictures will show that the machine is capable of performing all the ordinary hand strokes of grinding and polishing. A practically straight stroke can be imparted by substituting a long arm in place of the short one *H*.

"Pressure is obtained by clamping weights on connecting rod *F*. Fifteen pounds is sufficient up to the finest polishing, when no weight is desirable.

"The barrel on which the machine is mounted serves as an element of safety in case there is a tendency to grip; in this event it will tip. Gripping can be eliminated during the grinding by the use of a grooved lead lap in place of glass.

"There is an advantage in adding to the grinding mixture, something to increase the density as well as the gravity of the liquid, such as sugar or other inert substance, and thus retard the precipitation of the grits during the grinding process. The stirring device alone is not sufficient for the most satisfactory results.

"The laps are raised and lowered in the recessed tray *D* by means of rubber disks, and a thick rubber band is placed around the edge of each lap.

"One six-inch glass mirror was ground, polished and figured on the machine without any hand rubbing. A six-inch quartz mirror was made on it up to a polished sphere, and the final figuring was done by hand.

"The device is most satisfactory during the fine grinding and polishing. If a mirror has been overcorrected and is in the form of a hyperboloid or some other monstrosity, it is only necessary to put in a suitably trimmed lap and let the machine run by itself until the desired results are attained."

A Wellesley Enthusiast.

The Tree That Swallowed a Tree

THE letter quoted below explains itself. No finer source of quotation than John Muir, former guardian of the

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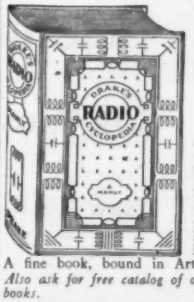

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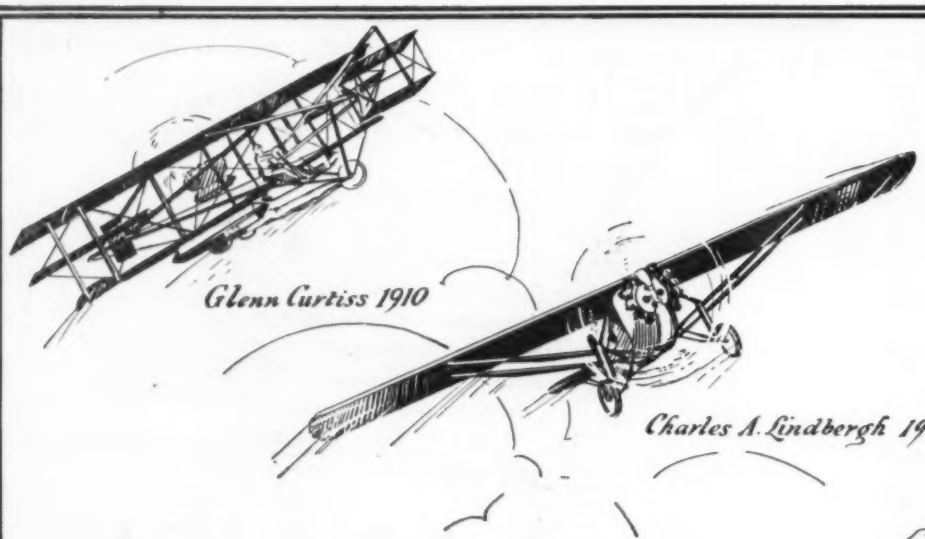

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nation's forests, could be chosen. John Muir is dead, but his books, including the one mentioned below, will ring down through the centuries when the white man has made of the Sierras a white man's shambles.

Editor, Scientific American:

In your September number, page 233, there is a note about a "tree that swallowed a tree." I wondered when reading it if the following, from John Muir's "My First Summer in the Sierra" would not explain it.

"Have been sketching a silver fir that stands on a granite ridge a few hundred yards to eastward of camp, a fine tree with a particular snow-storm story to tell. It is about 100 feet high, growing on bare rock, thrusting its roots into a weathered joint less than an inch wide, and bulging out to form a base to bear its weight. The storm came from the north while it was young and broke it down nearly to the ground, as is shown by the old, dead, weather-beaten top leaning out from the living trunk built up from a new shoot below the break. The annual rings of the trunk that have overgrown the dead sapling tell the year of the storm. Wonderful that a side branch forming a portion of one of the level collars that encircle the trunk of this species (*Abies magnifica*) should bend upward, grow erect, and take the place of the lost axis to form a new tree."

Yours very truly,
Isabel P. Jaggar,
Volcano House, Hawaii.

Worms as Artists

ONE of our readers, Mr. E. V. Morse, of Chesterland, Ohio, in the course of his wanderings through the woods has come across an interesting example

Certain types of wood - boring worms leave fancy designs. This is an excellent example of their work

of natural artistry. This is in the form of a section of tree trunk which has been "carved" in a unique manner by worms. Mr. Morse very kindly sent us this bit of wood, and a photograph of it is reproduced in these columns.

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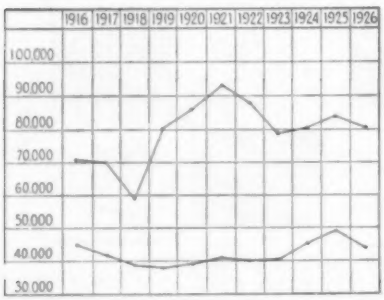
Commercial Property News

A Department of Facts and Notes of Interest to Patentees and Owners of Trademark Rights

CONDUCTED BY MILTON WRIGHT

Delays Are Fatal

THE disastrous results of delay in asserting claims in an interference action in the Patent Office are well illustrated by the recent decision of the Court of Appeals of the District of Columbia in refusing to permit Joseph J. O'Brien the right to appear as a claimant for a patent on an invention. The invention relates to certain improvements in forms for structures for plastic material and methods of applying continuous conduits. O'Brien filed his application in 1918; George A. Bonelli filed an application on a like invention in 1919. In 1922, no interference having been declared between the two applications, a patent was granted to Bonelli.



An anomaly in Patent Office statistics. The top line shows the number of patents applied for year by year; the bottom line the number of patents issued. You would think that the two lines would fluctuate in harmony—that the number of patents would increase or decrease in direct ratio with the number of applications. As a matter of fact, they do nothing of the sort. Patent Office officials have one explanation to offer and we have another. How do you figure it out?

In 1924, notwithstanding that more than two years had elapsed after the date of Bonelli's patent, the Examiner instituted an interference proceeding between the parties, O'Brien copying Bonelli's claim.

In 1925, priority was awarded to O'Brien, but afterwards the Examiner vacated this award upon the ground that O'Brien had no right to maintain the interference for the reason that more than two years had elapsed after the granting of Bonelli's patent. The appeal went up to the Court of Appeals of the District of Columbia, where the court held:

"The decisive question is whether O'Brien was entitled to be heard in the interference proceeding in view of the fact that more than two years had passed after the granting of Bonelli's patent, without the declaration of such an interference.

"This question is answered in the negative by Sundstand v. Gubelmann, 55 App. D. C. 200, wherein this court held that in the absence of special circumstance justifying the delay in copying claims from an issued patent, the two years' limitation applies, and there is no basis for the declaration of an interference."

The New Copyright Law

AS a result of legislation enacted by the last Congress, it is now possible to obtain copyright protection for published works produced by mimeograph, photo-lithograph, photo-engraving, photostat or similar process. Heretofore the specific requirement of the copyright law has been that a book or periodical must be "printed from type set within the limits of the United States . . . or from plates made within the limits of the United States from type set therein."

Explaining the new law, the Registrar of Copyrights, Thorvald Salberg, makes the following statement:

"The difficult situation brought about by the World War in regard to printing made it necessary or convenient in substitution for printing from type set, to resort to other methods for the production of many classes of books and periodicals. The exact number of such works is not known, but it is reasonably safe to believe that they numbered many thousands.

"University professors and other teachers in the higher schools and similar institutions have suffered seriously by this loss of copyright for their books because they were not printed from type set.

"It is certainly a reasonable proposition that the copyright granted to authors by Congress to protect their writings, as authorized by the Constitution, should not be lost to certain authors by reason of the requirements of our present copyright laws as to methods of production. This amendatory act allows the facts in relation to the publication and distribution of his book, to select his own method of production, and still be sure of his adequate protection from the time his work is actually published in the United States by any process of production.

"The enactment of this measure of relief from the restrictive type-setting requirements, in behalf of university professors and others, will also prove a considerable relief to the copyright office.

"Thus the law as amended permits the registration of copyright for books prepared in mimeograph, photo-engrav-

Patents Recently Issued

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Official copies of any patents listed in this section at 15c each; state patent number to insure receipt of desired patent copy.

Pertaining to Aeronautics

BALLOON CAPABLE OF BEING EMPLOYED AS A CAPTIVE OBSERVATION BALLOON AND AS A DIRIGIBLE—Comprising a gas bag, in combination with two interchangeable cars, viz., a wicker observation car, and a car provided with propelling means, both provided with suitable suspensions. Patent 1629374. L. Avorio, c/o L. Laboccetta, Via Due Marcelli 31, Rome, Italy.

WING CONSTRUCTION FOR AIRPLANES—Which is adjustably vibratory from the leading edge to the trailing edge for the purpose of producing a definite pulling action. Patent 1628940. J. Wenger, 721 Laurel St., Highland, Ill.

AIRPLANE WING CONSTRUCTION—Which permits of flying, taking off, climbing or alighting at slower speeds and with lesser angle than is usual. Patent 1630938. J. E. Griffin, Box 67-A, Route A, Savannah, Ga.

Chemical Processes

PROCESS AND APPARATUS FOR RECOVERING SILVER FROM PHOTOGRAPHER'S SPENT HYDROSULPHITE SOLUTION—Whereby the exhausted hypo-sulphite of soda is placed in a special equipment in which are disposed positive and electric plates forming electrolyte, whereby the silver will be deposited. Patent 1629212. E. K. Griffen, Salida, Colo.

Electrical Devices

CAP OR SOCKET FOR INCANDESCENT ELECTRIC LAMPS AND THE LIKE—By means of which soldering between the parts may be carried on, without danger of the soldering iron or blow-pipe approaching too near the bulb. Patent 1630126. A. J. B. Marsat, c/o C. Chassevent, 11 Boulevard de Magenta, Paris, France.

ELECTRICAL-TUBE-CONNECTER TWISTING DEVICE—Especially adapted for splicing two electrical conductors together, by a ratchet mechanism, where little clearance room can be had for performing the operation. Patent 1629800. W. J. Leach, 715 Pine St., Burlington, Wis.

LOGGING DEVICE FOR RADIO TUNING INSTRUMENTS—Adapted for disposition upon radio couplers employed in the ordinary radio circuit for turning the shaft to tune the instrument in selecting certain stations. Patent 1630302. E. H. Larson, 5857 Byron St., Chicago, Ill.

ing, or similar processes if duly published by offering such copies publicly for sale or for other public distribution. The office requires an affidavit of actual publication. If not publicly offered for sale, the copies must be published by public distribution without specific limitation on those to whom it might be circulated.

A Good Word For Trusts

TO the Planning Committee of the International Economic Conference at Geneva, Paul de Rousiers, professor at the Ecole des Sciences, Paris, has made a report recommending statutory regulation for trusts and combines. The report traces the organization of cartels in Germany, trusts in the United States, amalgamations in England and associations and agreements in France and other countries. It outlines the organization of international trusts and agreements and in this connection specifically discusses the United States Steel Corporation, the Standard Oil Company, the German dye trust and the potash and steel consortiums.

"The charge most often advanced against agreements is that they tend to put up selling prices," says Prof. de Rousiers. "This charge applies chiefly to the early days of the cartels; it is based upon the fact that at times of crises, when prices are falling, agreements are instrumental in keeping them above the level to which they would otherwise drop. All the inquiries carried out in Germany, Great Britain and the United States prove, however, that when there is an upward tendency, the cartels exercise a contrary influence and keep prices below the level they would otherwise attain.

"In other words, they have a stabilizing and regularising action. Thanks to them, price curves less frequently assume those acute angles which confound all estimates, discourage initiative and give industry the appearance of a disastrous gamble. They are thus of benefit not only to the producers but also to their customers.

"Agreements offer the clientele a further very important advantage, namely, that of paying prices which are not only less variable than formerly but are always uniform for everyone alike, at any given moment. This benefit is of special value to small purchasers; it ensures them real protection."

Grade Marks And Trade Marks

CAN a grade mark be a trademark? The question came up recently in a Patent Office opposition proceeding between Oakford and Fahnestock versus King Midas Mill Company against the registration by the King Midas Company of "White Oak" as a trademark for flour. In dismissing the opposition and holding the trademark entitled to registration, Assistant Patent Commissioner M. J. Moore says:

"There is certainly nothing about said mark to suggest quality or grade. The mark is clearly arbitrary and fanciful when appropriated to flour, and is used primarily to distinguish the applicant's goods from like goods of other traders. The fact, assuming it to be a fact, that the applicant has other trademarks appropriated to the same goods, is immaterial. As was stated by Judge Learned Hand:

" 'Now, in principle there is no possible ground for refusing to recognize any number of trademarks which are really such.'

"It is also well settled that there may be different trademarks for different grades or qualities of the same product, provided they are so used to distinctly indicate origin or ownership as well as grade."

Of Interest to Farmers

TOBACCO HARVESTER—By the use of which it is possible to transfer the leaves to drying sticks almost immediately upon harvesting them, without bruising by excessive handling. Patent 1629442. J. C. Trulove, Shoals, N. C.

Of General Interest

COMBINATION DRAIN BOARD AND COVER—Formed from one piece of metal which seats down in the body of a combination sink and laundry tray structure preventing the spilling of water. Patent 1628746. J. W. Russel, 522 Chestnut St., Columbia, Pa.

FACIAL-WRINKLE-REMOVING DEVICE—Readily applied to any portion of the face, for exerting the proper directional pull in the endeavor to remove wrinkles, without undue discomfort. Patent 1629460. H. A. Skinner, 44 Pearl St., New York, N. Y.

HOSE FASTENER—Particularly intended for bathroom attachments such as showers, the attachment having means for tightening the grip on the faucet as the water pressure increases. Patent 1629431. B. W. Bennett, 1 So. Clinton Ave., Bayshore, N. Y.

METHOD OF PRODUCING COMPOSITE MOVING-PICTURE FILMS—For so-called freak pictures, by providing a plurality of identical positive film strips and super-imposing them to register when viewed through frames... Patent 1627976. A. V. Knechtel, 1179 North Kenmore, Los Angeles, Calif.

PIPE-SEALING DEVICE—Which will cause a leak to be properly sealed without requiring the flow of liquid to be cut off during the operation. Patent 1627995. W. J. Pendry, Box 818, Martinez, Calif.

SAFETY RAZOR—In which a special holder greatly facilitates the manipulation insuring the proper relation of the cutting edge during shaving, and precludes accidental displacement of the blade. Patent 1629416. J. and M. Roman, c/o Max Roman, 267 Clifton Place, Brooklyn, N. Y.

WALL CONSTRUCTION—Wherein a special interlocking pre-cast block is used and locked in wall formation by the pouring of concrete between the assembled blocks. Patent 1627986. J. McKenzie, 11 North St., Whangarei, Auchland, New Zealand.

COMBINATION CANDY BOX AND TOY HOUSE—Which when opened can be easily assembled to form a toy house, even when the candy is still in the box. Patent 1630117. D. C. Faulkner, 461 8th Ave., New York, N. Y.

CARPET SPOOL—Wherein a journal is provided with means for efficiently holding the same in place, and a support arranged to carry a removable head. Patent 1630155. W. H. Wilson, c/o Vermont Spool and Bobbin Co., Burlington, Vt.

FINGER NAIL TRIMMER—Including a handle having at one end a nail cleaner and at its other end a nail trimmer, both protected by threaded caps. Patent 1629967. R. K. Rex, 2224 Overlook Road, Cleveland, Ohio.

BRIDGE APPROACH—In the form of a spiral ramp of double or single character associated with the floors of a building, which may be additionally employed for storage purposes. Patent 1629787. A. S. Hackett, 515 Whitney Central Bldg., New Orleans, La.

CARD RACK—Which functions to support a plurality of playing cards in substantially upright position, so as to be clearly visible and readily insertable or removable. Patent 1629070. H, T, Cox, 5676 York Blvd., Los Angeles, Calif.

Each Sock Stands Alone

IS a pair of socks singular or plural? Authorities on grammar may think a pair of socks is a unit and takes a singular verb. Singularly enough, however, the United States Customs Court says a pair of socks is plural and takes a plural import marking.

The Irish Textile Company found this out recently when it imported woolen hosiery into the country. The proper legal marking was placed on one sock of each pair. It was not enough, the court held, whereupon it imposed an additional penalty of 10 percent upon each unmarked sock. For tariff purposes each sock is regarded as a separate article of commerce and therefore each one must be marked.

The Katz Underwear

THE Katz Underwear Company is denied the privilege of registering a picture of a cat's head as a trademark, because of the likelihood of confusion with the cat's-head trademark registered by the Corticelli Silk Co. This decision is made by the Patent Commissioner in spite of the fact that for years the Katz Company used as its trademark a picture of three cats. The Corticelli uses the cat's head for spool silk, but also has used it on stamped linens, braids, dress silks, underwear and hosiery, although its use on some of these goods has been discontinued. The Katz Company desired to register a similar mark for underwear.

"The issue here," says Assistant Commissioner Kinnan, "is the old one so often decided by this court: would appellant's use of the mark on underwear lead the ordinary purchaser to believe that he was buying the goods of appellee? We think the word 'class,' as used in the statute, means broadly a genus including as species any goods upon which the use of the same mark, when the goods are exposed side by side, would tend to mislead the purchasing public. We have no difficulty in applying this rule to knitted and textile undershirts, drawers, and union suits on the one hand, and men's, women's, and children's stockings on the other.

"The examiner points out that each party has used his mark for several years, and that opposer has not submitted proofs of actual confusion in trade. This act is not deemed controlling. The opposer, as is well settled, is not required to prove actual confusion; the establishing of the likelihood of confusion is sufficient. Opposer was long prior in the field with the cat's-head mark, even using it on underwear before and at the time applicant adopted the cat's-head mark."

CEMENTING HEAD—Of simple and durable construction, having locking means by which the head can be quickly attached to or detached from an oil well casing. Patent 1629022. H. A. and C. F. Davis, c/o H. A. Davis, Box 138, R. D. 1, Redwood, Calif.

DISPLAY DEVICE—In the nature of an emblem, which is attractive and ornamental in appearance, reversible, and adapted to carry diversified subject-matter on its two faces. Patent 1630917. H. D. Andrews, 43 Glencoe Place, Cincinnati, Ohio.

MILK-BOTTLE HOLDER—Having a latch which automatically secures the jaws around the bottle neck when the latter is inserted, the bottle will not drop when bolt is unlocked. Patent 1630409. T. C. Rouse, 1322 15th St., N. W., Washington, D. C.

SPRAY NOZZLE—Which will thoroughly and evenly distribute viscous liquid, such as oil or tar, to a road way, without choking or clogging. Patent 1630974. O. W. Shelor, and E. G. Butts, c/o Klime & Klime, Roanoke Ry. & Electric Mfg. Co., Salem, Va.

ANIMAL TRAP—For small animals such as mice or rats, adapted to be actuated by pressure applied at any point of a relatively great area. Patent 1630969. J. E. Ruby, Waynoka, Okla.

VENTILATOR—For the roof of a building, giving maximum ventilation and minimum danger of freezing the mechanism while reducing the power required in operation. Patent 1630978. J. Sobel, 214 E. 127th St., New York, N. Y.

CONFECTION PACKAGE—So constructed as to form a strong compact box for the sale of confections, including a display tray for exposing the goods without necessitating unpackin . Patent 1630984. A. Sweet, c/o Sweet Candy Co., Salt Lake City, Utah.

ANIMAL TRAP—In which nothing projects above the jaws in set position, which eliminates the necessty for a trigger or other form of trip member and will not destroy fur. Patent 1630607. W. Catlin, Rockville, Ind.

JAR CLOSURE—Including a screw cap and a closure cap which can be readily operated to hermetically seal the contents and allow of ready opening. Patent 1629639. J. O. Rollins, 1435 Federal Ave., Sawtelle, Calif.

Hardware and Tools

SPIRIT LEVEL—Which is provided with adjusting means, and embodies a level equipped with two level glasses at right angles to each other. Patent 1630122. V. E. Ivarson, Box 516, New Rochelle, N. Y.

SASH FASTENER—Acting automatically to hold the sashes against vertical movement in their slideways, the latching means being operable only from the inside of the window. Patent 1630153. J. T. Williams, Box 430, Arcade Sta., Los Angeles, Calif.

MARKER BLOCK—Particularly useful to carpenters in marking off spaces on the edges of doors which are to be mortised for the reception of hinges. Patent 1629053. C. C. Schrader, Box 86, Hughson, Calif.

GUTTER HANGER—For supporting gutters adjacent the edges of roofs, which permits the use of narrow bridge stock without detracting from strength, and eliminates riveting. Patent 1630961. C. A. Meunier, 315 Memoria St., Great Neck, L. I., N. Y.

Heating and Lighting

DRYING APPARATUS—Which affords facilities for the utilization of heat from any ordinary supply, to effect practically a complete drying of cloth, textiles and the like. Patent 1630652. M. E. Bussler, 521 St. Philip St., New Orleans, La.

Machines and Mechanical Devices

ATTACHING MEANS FOR MULTIGRAPH SIGNATURE PLATES—For attaching the signature bearing element to the platen roll of a multigraphing machine and holding the same in perfect contact. Patent 1629376. H. T. Buck, c/o T. S. Buck Mfg. Co., 87 Duane St., New York, N. Y.

BOAT-LAUNCHING DEVICE—Whereby the swinging of the boat outboard and the lowering into the water can be controlled by one man from the boat. Patent 1629419. H. L. Sorensen, 877 59th St., Brooklyn, N. Y.

COIN-CONTROLLED LOCK—Consisting of a number of co-acting parts for permitting the key to lock the door only after a coin has been inserted in the lock. Patent 1628711. W. J. Dobkin, 3210 Arthington St., Chicago, Ill.

REFRIGERATING APPARATUS—Requiring a relatively small space, in which compressed air is employed as the refrigerating medium and the moisture eliminated to insure proper operation of the machine. Patent. 1628820. C. R. Bushnell, Lake Hughes, Los Angeles, Calif.

SHOE-RAISING-PLATFORM DEVICE—In which a lazy tongue structure is used in elevating a platform, and when actuated by the foot the effective height of the operator is varied. Patent 1630191. C. Liberman, 1732 Madison Ave., New York, N. Y.

MOP-ASSEMBLING APPARATUS—Wherein an internally groved ring is employed over which the strands are run, and in said ring binding wires are located for securing the inner runs of the yarn. Patent 1630187. M. Kenner, 8304 Fig St., New Orleans, La.

OVERHEAD CONVEYER—For releasably maintaining an object, such as a log, that is to be carried a given distance, below the carrier, and operate from the ground. Patent 1630959. R. A. McCourry, Knappa, Oregon.

SCRAPER SHOE—For prolonging the life of an ordinary scraper bucket; may be not only applied to old shoe supports, but to broken ones also. Patent 1629785. C. E. Gilbert, c/o Gilbert Mfg. Co., Stillwater, Minn.

SPEED INDICATOR—In which a steel ball revolving in a channel drops in certain positions at low speed, creating a sound, but will not drop at high speed. Patent 1630963. F. Mortensen, c/o Maskinach Brolyggrads Aktiebolaget, Helsingfords, Finland.

Prime Movers and Their Accessories

FUEL MIXER—Including a fan disposed across the path of the moving fuel for churning the combustible mixture into fine mist readily intermingled with the incoming air. Patent 1630161. H. Bornheim, 15 Berwick St., Everett, Mass.

Railways and Their Accessories

RAIL OBSTACLE—Which comprises a trip member, and means for the attachment of the same to a track element, to prevent unintentional movement of a carriage or train. Patent 1628552. J. B. O'Connor, 163 Eastern Parkway, Brooklyn, N. Y.

RAIL-CAR TRANSFER—A wheeled frame with slidable car rails mounted thereon for relative longitudinal movement, for use in connection with cars that are manually operated. Patent 1629805. J. F. McCarroll, c/o Standard Machine Co., Baton Rouge, La.

Pertaining to Recreation

GAME APPARATUS— In which a spinning top, upon an eccentrically rotatable table is shifted by the action of the table into any one of a series of pockets. Patent 1629383. S. Hisanosuke, c/o Mrs. A. Morse, East Shore Road, Great Neck, L. I., N. Y.

DIVISION BOARD FOR BOWLING ALLEYS—Which is practically indestructible, having striking plates of soft, tough material, not liable to sliver, and extending the entire impact area of the board. Patent 1628844. C. B. Houser, 542 No. 23rd St., East St. Louis, Ill.

Pertaining to Vehicles

LUBRICATING SYSTEM.—Which is in continuous operation while the vehicle is traveling, forcing a lubricant in minute quantities into various bearings for shackles, springs, etc. Patent 1623240. C. C. Goodrich, 639 Turk St., San Francisco, Calif.

AUTOMOBILE LOCK.—For the transmission of automobiles, adapted to engage keepers on the shifter rods for locking the rods against movement. Patent 1625249. M. Farah, 104 So. Leon St., El Paso, Tex.

SHOCK ABSORBER.—Of the liquid controlled type, having a single compartment and means for controlling the parts therein, is accessible by the removal of a single screw. Patent 1624265. H. H. Logan, 6107 Newburg, Norwood Park, Chicago, Ill.

CABLE BRAKE.—Comprising a brake drum, a cable wrapped more than once around the drum and a retractive spring for each end of the cable. Patent 1622785. W. F. Hollingsworth, 104 7th St., San Francisco, Calif.

PARKING DEVICE FOR MOTOR VEHICLES.—For the expeditious parking of a car in relatively short spaces such as are frequently found between cars along-side street curbings. Patent 1622802. J. Myers, Oroville, Calif.

REFLECTOR-JEWEL MOUNTING.—Such as are used at the rear of bicycles, automobiles, or other vehicles, which may be mounted without drilling a hole in the fender or mudguard. Patent 1624300. J. E. Wood, 1622 So. Wabash Ave., Chicago, Ill.

MOTOR-VEHICLE HEATER.—Of the "exhaust heater" type, arranged in the floor of a tonneau in such manner that dirt will not collect and give off offensive odors. Patent 1623879. E. W. Leahy, c/o Albrass Co., Coxsackie, N. Y.

AUTOMOBILE BRAKE AND JACK.—Which will not only brake a vehicle, but will also prevent skidding, and may be employed as a jack. Patent 1625226. C. Simmons, 437 So. Center St., Reno, Nev.

TIRE SPREADER.—Which may be conveniently used with all sizes of tires for opening up the tire throughout its entire length to permit inspection of the shoe. Patent 1626460. V. R. Goeller, c/o Mountain Lakes Service Station, Mountain Lakes, N. J.

CIRCUIT-CONTROLLING APPARATUS.—Adapted for use in controlling the bright and dim lamps of head lights, and maintaining control of the steering wheel during such operation. Patent 1625832. M. A. Stein, c/o Mays & Rouse, Hoperville, Va.

RETRACTABLE VEHICLE RUNNER.—A sled runner attachment for wheeled vehicles, such as automobiles, aeroplanes, and the like, which may be quickly removed to an inactive position above the wheels. Patent 1627151. D. De Wald, 1613 Mt. Vernon Ave., Orlando, Fla.

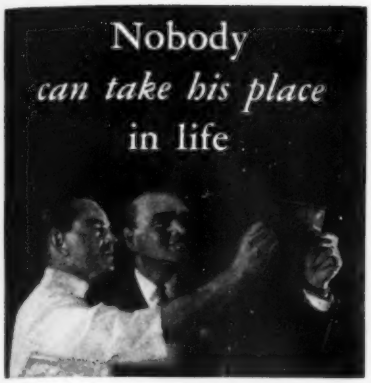
Designs

DESIGN FOR A SHOE—Patent 72685. Maude Siegel, c/o Franklin Simon & Co., 38th St. & 5th Ave., New York, N. Y.

DESIGN FOR A SHOE—Patent 72731. Maude Seigel, c/o Franklin Simon & Co., 38th St. & 5th Ave., New York, N. Y.

DESIGN FOR A COMBINED MATCH HOLDER AND CIGARETTE CONTAINER—Patent 72745. W. G. Wolford, 435 Cecilia Ave., Cliffside, N. J.

DESIGN FOR A COMBINATION BATHROOM FIXTURE—Patent 72691. J. H. Balmer, 259 Plane St., Newark, N. J.



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SCIENTIFIC AMERICAN PUBLISHING COMPANY

Munn & Company, 24-26 West 40th Street, New York

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Vol. 137, No. 2. Price 35 cents a copy. $4.00 a year. Postage prepaid in United States and possessions and foreign countries where eighth zone rates apply. Other Foreign countries $5.00 a year, postage prepaid. Canada $4.50 a year postage prepaid.

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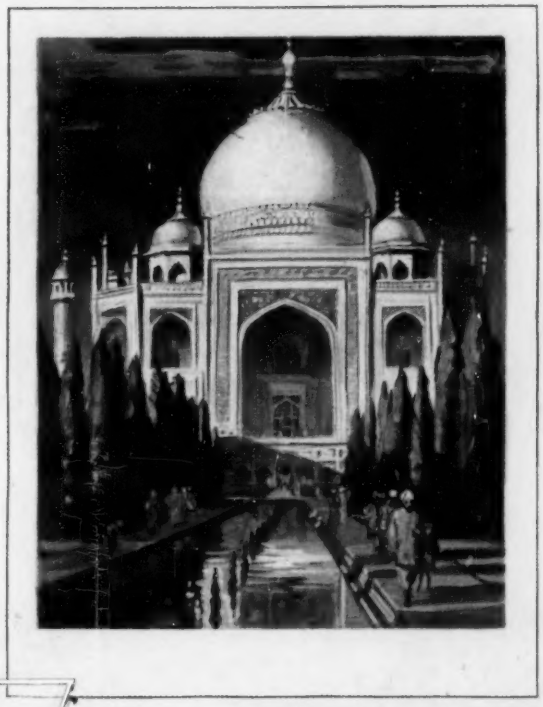

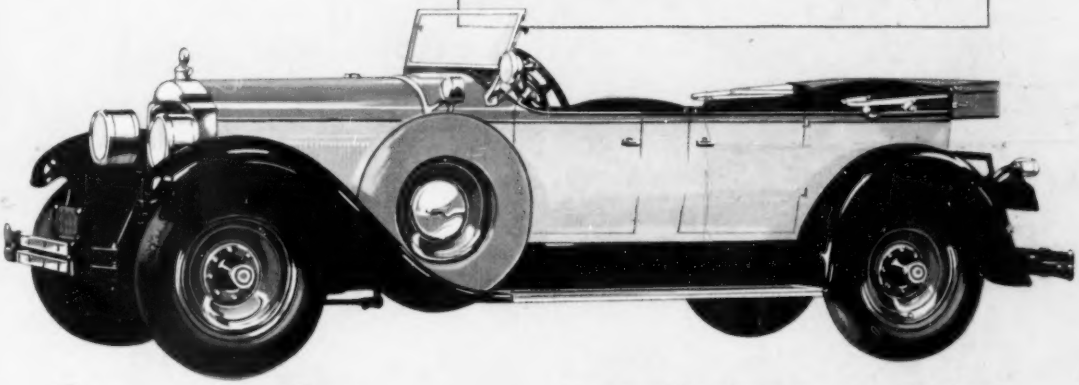

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